ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

Vol. XXXV. No. 3.

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The Massachusetts Metropolitan Water Board, through its Chief Engineer, Mr. F. P. Stearns, calls the attention of contractors to the large amount of work to be done in the near future under its direction. Proposals are now asked for Sections 2 and 3 of the Nashua aqueduct but after these are let there will remain nearly 7 miles of masonry aqueduct to be built in open trench, and about 3 miles of large open channels Plans and specifications for this are now being prepared and surveys already made. Reservoir No. 5, which is to be finished by the Board, still requires work to the amount of nearly $1,000,000, and this is to be let early in the spring. In the vicinity of Boston 50 miles of large pipe are to be laid, and pumping stations and distributing reservoirs are to be built; and some of this work will be let in a month or two. A reservoir is to be built upon the Nashua River, including a masonry dam raising the water 100 ft or more, and about 5,500,000 cu. yds. of said dam to be removed from a territory of 6¼ sq. miles. Dikes have to be constructed; 6¼ miles of railway and 19 miles of highways must be rebuilt on flooded areas, and this work includes some large bridges. The total estimated cost of this dam and reservoir is $9,000,000. The plans and specifications on the work in connection with this great reservoir will require some time yet for proper preparation; but they may be completed in time for letting in the autumn of this year, or in the spring of 1897.

The East Jersey Water Company has given notice to Jersey City that it will not be able to furnish the 20,000,000 gallons daily from its Pequannock Brook water shed, as contracted for, owing to a mistake in estimating the carrying capacity of the conduit. This supply was to come from the surplus after supplying Newark, but the water company now says that only 12,000,000 gallons daily are now available for this purpose. The total carrying capacity of the conduit was estimated at 50,000,000 gallons daily, but it will not exceed 35,000,000 gallons. This mistake was only recently discovered, said Chief Engineer Hersehell, though enough was known several weeks ago to show by calculating that the capacity was at least 5,000,000 gallons short. The company now proposes to lay another 48 in. main. The Jersey City authorities are much excited over the result, as it compels them to continue the polluted Passaic water for the bulk of their supply.

Washings from the coal mines and culm banks of Central Pennsylvania are seriously effecting the water supplied to Philadelphia, both from the Schuylkill and the Delaware Rivers. The water is almost black and is not used by those who can obtain water from any other source. The trouble will continue until the present high water in these rivers subsides. It is said that this fine coal dust deposit is gradually silting up the pipes of the distribution system and seriously interferes with the pumps.

The Bronx Valley Sewer Commission has presented the following report through its Consulting Engr., Mr. J. James R. Croes, M. Am. Soc. C. E.: The Bronx Valley has an area equal to that of New York city, with but one outlet to tidewater. It is not deemed advisable to construct a series of sewage disposal works in the valley; nor is it practicable to arch over and use the Bronx River for sewerage and drainage purposes. An intercepting sewer is recommended, with storm-water overflow, commencing at Kensico, with a 2 ft. pipe sewer; at White Plains this would connect with the equivalent of a 3-ft. circular brick sewer; increasing to 3½ ft. in diameter between Hartsdale and Tuckahoe; 4 ft. at Woodlawn, and 5 ft. in diameter from Woodlawn to the outlet. The proposed outlet is at High Island in Long Island Sound, near the north end of City Island, and where the ebb tide flows eastward. The length of the sewer, from Kensico to High Island would be about 21.7 miles, and the estimated cost of construction, inclusive of land damages, easements, river improvement and all expenses, is $3,617,310. The size of the sewer is based upon a prospective population of 450,000 in the whole Bronx water-shed north of West Farms, and 45,000 north of White Plains.

The Wards Island Bridge Company is seeking incorporation at Albany for the purpose of erecting a bridge across the East River by way of Wards Island. Senator Ahearn, in introducing the bill, said that the bridge was intended to provide a direct communication for passenger traffic between Brooklyn and Long Island City and the annexed district of New York city, and a direct connection with railways in that district. The bill names three commissioners—James W. Covert, Queens County; Thomas H. Bauchle, and James C. Reed, of New York. Two more commissioners would be appointed by the Mayors of New York and Long Island City. For the benefit of some already making inquiries at this office concerning this bridge it might be said that the above item contains all that is now made public about this project Plans, estimates, permission to build and money to build with are still questions of the future.

The Montreal Bridge Company, which for some years past has been working upon a project for bridging the St. Lawrence River, at Montreal, is reported to have concluded arrangements with a New York syndicate for the construction of the bridge. What these arrangements are is not stated. The Dominion Government chartered this bridge some time ago, giving the company the right to issue $3,000,000 in bonds and fixing the height of the bridge at 170 ft. above the surface of the river; this latter stipulation was afterward changed to 150 ft. and the capital was increased to $6,000,000. It is said that the bridge now proposed is to cost about $6,000,000 and it is to cross the river by way of Isle Ronde. It is also understood that the company is to receive the customary aid of 15% from the Dominion Parliament, says the Montreal "Gazette."

The new East River bridge commissioners are seeking permission from the Secretary of War to have the clear light of the bridge above the water surface decreased to 135 ft. They believe that the saving of 5 ft. in height will mean a decrease of $1,000,000 in the estimated cost of construction.

The old wooden drawbridge, operated by hand power, which now crosses Newtow Creek at Vernon Ave., Long Island City, N. Y., has long been condemned by the War Department, but so far the county authorities have failed to provide for a new structure. The department has now extended the time for compliance with its orders to March 1, with the proviso that no further extension will be granted, but that the old structure will be removed and the penalties against the authorites enforced for obstructing navigation.

The most serious railway accident of the week was a glancing collision between an express train and a derailed car of a freight train, Jan. 9, at Franklin Park, Ill., on the Chicago, Milwaukee & St. Paul Ry. The car left the track just as the express was passing, smashing the cab and killing the fireman. The engine was badly damaged.

A train entering the terminal station of the Chestnut Hill branch of the Philadelphia & Reading R. R. at Chestnut Hill, near Philadelphia, Pa., Jan. 7, got beyond control of the brakes, smashed the bumpers, ran across the 12-ft. platform at the end of the tracks, and broke through the wall of the station, the front of the engine projecting out on the sidewalk. Nobody was injured.

A rear collision occurred on the Lake Street Elevated R. R., at Chicago, Jan. 6. One train was standing in the Canal St. station at the time. Nobody was seriously hurt.

An iron viaduct over Tinker's Creek, near Cleveland, O., on the Akron, Bedford & Cleveland Electric Ry., collapsed Jan. 9 under a train consisting of a motor car with snow plow and a coal car. Three men were in the train, two of whom were killed. The structure was built last summer by the Wrought Iron Bridge Co., of Canton, O., and was 364 ft. long, with a deck truss span of 140 ft. over the creek, this truss supporting the trestle floor, which was above the top chord. The bridge was on a grade, and the train was going up the grade at the time of the accident. The collapse allowed the greater part of the structure to fall almost vertically.

A masonry tower at Lena, Ill., supporting a water tank collapsed on Dec. 25. The tower was 90 ft. in height, and had just been completed for the public water supply of the town. The failure is ascribed to a weak foundation, and to the building of the tower during severe weather, when the mortar became frozen before setting.

An unusual number of boiler and other explosions are recorded in our daily press exchanges this week. The cold weather seems to be in some way accountable for these accidents, for a "cold snap" always seems to bring a crop of them. It would be interesting to learn if the cold has as much influence on a steam boiler as it has upon its attendant, and whether the chief cause of a greater number of explosions in cold weather is not unusual neglect of precaution at that time.

Among the boiler explosions were one at the pumping station of the Chicago & Erie R. R., in Decatur, Ill., on Jan. 6, which demolished the building and seriously injured an employee; one at a slaughter house in Mount Joy, Pa., on Jan. 8, in which one man was fatally injured; one at a saw mill near Manchester, Ind., on Jan. 3, in which one man was hurled 200 ft. away and instantly killed, and three others seriously injured. A hot water heater in a gymnasium in Manchester, N. H., exploded on Jan. 4, tearing a hole through a brick wall. A steam pipe burst on the tug Henry M. Palmer, as the boat lay at the foot of N. Sixth street, in Brooklyn, on Jan. 6. A gas engine exploded in New Orleans, La., on Jan. 5. In all of these cases the reports do not mention the probable causes.

An explosion of combustible gases arising from a boiling vat of a compound for insulating electric wires took place in the repair shops of the Cleveland Telephone Co. on Jan. 6, seriously injuring a workman and almost entirely destroying the shops. It is supposed to have been caused by the liquid boiling over and running on cracks of the furnace under the vat.

A large number of underground telegraph and electric lighting cables at Allegheny, Pa., are said to have been ruined and rendered useless by electrolytic corrosion resulting from currents escaping from the electric railways. Gas and water mains have also suffered severely. Overhead wires are being substituted for the underground cables, and some means of protection for the pipes will be adopted.

A plan for improved terminal switching facilities at Cincinnati, O., has been presented to the Chamber of Commerce by Mr. M. E. Ingalls, President of the Chesapeake & Ohio Ry. His plan is that the Union Switching Co. should get the right of way for tracks from Cummingsville, along the canal to 14th St., where a union freight depot would be built. This would require probably $750,000, the company to have its own engines and do all switching, using other railway tracks, including the street connections, on a basis of charge to be agreed upon with the railways or fixed by arbitration. He would raise the capital by having each railway subscribe, and he believes the entire stock could be placed in a day if the right to switch in the bottoms and at all hours of the day were given. Plans and estimates for the necessary structures, tracks and other work, including the improvement of the Miami & Erie Canal, have been prepared by Mr. Robert L. Read, M. Am. Soc. C. E.

An increase of railway facilities for Milwaukee, Wis., is being urged by the merchants and other large freight shippers, and committees have been appointed to lay propositions for terminals before various of the southern and eastern lines for the purpose of inducing them to extend their lines north to that city. No very definite plans seem to have been formulated, but the scheme most discussed is the construction of a belt line with a terminal station in the city. It is suggested that this belt line be opened to the use of all railways at a uniform trackage rental. With such an assurance of good terminal facilities it is thought that some of the lines now entering Chicago from the east and south will favorably consider an extension to Milwaukee. The common council, merchants' association and chamber of commerce are all pushing the scheme.

The depression of the Long Island R. R. tracks on Atlantic Ave., Brooklyn, N. Y., so as to avoid the present numerous and dangerous grade crossings, is the subject of a bill introduced in the State Senate. Such a change has long been desired, but legislation to this effect has so far failed of success.

PASSENGER STATION FOR CHICAGO & ALTON R. R., SPRINGFIELD, ILL.

We illustrate in the accompanying cut a general view and floor plan of a very attractive passenger station recently built at Springfield, Ill., by the Chicago & Alton R. R. Co. This station was designed by Mr. S. S. Beman, architect, Chicago, Ill., and the contractor for its erection was Chas. B. Post, of Chicago, Ill. We are indebted to Mr. H. C. Draper, Chief Engineer, Chicago & Alton R. R., for the matter from which our illustrations have been prepared.

Fig. 1 is a general view of the station from the southwest and Fig. 2 is a plan of the ground floor,

FIG. 1.—VIEW OF PASSENGER STATION FOR CHICAGO & ALTON R. R., SPRINGFIELD, ILL.
S. S. Beman, Chicago, Ill., Architect; H. C. Draper, Chicago, Ill., Chief Engineer.

which clearly explains the general arrangement of the waiting rooms and other accommodations. Underneath the main floor there is a basement with a concrete floor. The foundations are of stone masonry. The exterior walls are built of St. Louis buff pressed brick, except of course the stone foundation and water table, and the roof is of red tile with copper gutters and flushings. The platform is of concrete topped with granite chips. The inside walls are light colored pressed and enameled brick with marble base and side courses and red oak finish and ceiling. The floors are of mosaic. There are gas and electric lights and steam heat. Further details of the inside finish and special fittings are shown by the plan, Fig. 2.

THE PRESIDENTS OF FOUR AMERICAN ENGINEERING SOCIETIES.

(With Inset)

We present to our readers this week upon an inset sheet, the portraits of the Presidents of the four American National Engineering Societies, and give herewith a brief account of the life and professional career of each. The readers of Engineering News are aware that very little space in its pages is spared to matters of a purely personal nature. When, however, an engineer is honored by the fellow members of his profession with the highest and most honorable position that is in their power to bestow, his personality becomes a matter of interest to the profession and the accompanying notes and portraits will we trust be appreciated by our readers.

Mr. Thomas Curtis Clarke, who has just been elected President of the American Society of Civil Engineers, was born in Newton, Mass., Sept. 16, 1827, and is a younger brother of the eminent divine, the late Rev. James Freeman Clarke. He graduated from the Boston Latin School in 1844, and from Harvard College in 1848. After graduation Mr. Clarke commenced the study of engineering under Capt. John Childe, of Springfield, Mass., a graduate of West Point and one of the first of army officers to enter the then new field of railway engineering, and in which field he achieved wide fame. Mr. Clarke, in his long professional career, has been engaged on various railways in the South and West, and in Canada. He early became deeply interested in railway bridge construction, and he designed and built the second railway bridge over the Mississippi River, at Quincy, Ill. As senior member of the firm of Clarke, Reeves & Co., of Phoenixville, Pa., he built many bridges in various sections of the country, among them the Girard Avenue bridge, in Philadelphia, the famous Kinzua viaduct, and about half of the elevated railways in New York. In 1884 Mr. Clarke became a member of the Union Bridge Co., of New York, and as a member of that firm was connected with the design and erection of the Hawkesbury bridge in New South Wales, with foundations 185 ft. below high water, and the Poughkeepsie bridge over the Hudson River, with foundations 135 ft. deep and cantilever spans, of 548 ft.

During Mr. Clarke's connection with the Phoenix and the Union Bridge companies he not only had to design but to execute with his own men and machines many deep and difficult submarine foundations. In none of these has there been any failure, nor any accidents involving the loss of life.

He was one of the earliest among engineers to introduce (at the Quincy Bridge) the use of concrete on a very large scale in bridge foundations and piers, which is now so common.

He also shares with the late C. Shaler Smith the credit of being one of the first designers of the modern railway metallic viaduct with braced towers and connecting spans.

Since his retirement from the Union Bridge Co., Mr. Clarke has been in consulting practice. He was for a time chief engineer of one of the proposed bridges across the Hudson River at New York, and he has designed a bridge for the crossing of the Mississippi River at New Orleans. He was also consulting engineer in 1891 for the West End Railway Co., of Boston, in connection with proposed subway connection.

Mr. Clarke was made a member of the American Society of Civil Engineers on March 18, 1868, and a member of the Institution of Civil Engineers of London, on May 5, 1874. He was also one of the founders of and at one time president of the Engineers' Club of Philadelphia. He has contributed many professional papers to these societies, and has been awarded the Telford premium and gold medal from the Institution of Civil Engineers for a paper upon American bridges.

Of the many eminent engineers who have held the distinguished position of President of the American Society of Mechanical Engineers, no one has more highly deserved that honor than Mr. John Fritz, who was elected at the November meeting. Only two years before, he was elected to the presidency of the American Institute of Mining Engineers. He would have been elected to this office in both of these societies years ago save for his disinclination to accept such election during his active business career, for no man in the whole membership of the two societies has been more highly esteemed or has had a wider circle of friends.

Mr. Fritz was born Aug. 21, 1822, in Londonderry Township, Chester County, Pennsylvania. His boyhood was spent chiefly upon a farm, and at the age of 16, when as a blacksmith's apprentice, he gained his first acquaintance with the manufacture of iron, at a charcoal blast furnace to which he was sent to do some repair work. In 1845 he went to Norristown, Pa., and assisted in the building of what was then considered to be the best mill for making bar iron in the country, and soon afterwards he was placed in charge of it during the night turn, and later during the day turn. He thus became a manager of iron works, in which line of industry he continued, as manager and engineer, until his retirement from active work at the Bethlehem Iron Works in 1892, when he was more than 70 years of age. In 1854 he went to Johnstown, Pa., to take charge of rebuilding the rail mill of the Cambria Iron Co., which had been leased by Mr. David Reeves and his associates after the failure of the company. Here in 1857 he built the first three-high rail mill ever built, carrying out the work in the face of strong opposition both of the workmen and of some of the owners of the plant. It was so successful as to establish his reputation as a rolling mill engineer. In 1860 he was called to be general superintendent of the then newly organized Bethlehem Iron Co., which position he held for over 32 years. The iron mills were started in 1863, and the Bessemer Steel Works in 1873. In 1886 the Bethlehem works was the first to engage in the manufacture for the government of hydraulic-forged open hearth steel armor plate and forgings for heavy guns, and a complete new plant was built under Mr. Fritz's directions, for making and shaping and tempering the steel. The first heat in the steel department was made Aug. 11, 1888. The new works are the finest of their kind in the world, including a 125-ton hammer; a 14,000-ton hydraulic forging press, and a machine shop for finishing the heaviest gun forgings. The success of the company in completing its government contracts is a matter of recent history. On Sept. 30, 1892, at the instigation of some members of the Engineers' Club of New York City, a complimentary dinner was given to Mr. Fritz at the Opera House in Bethlehem, Pa., to celebrate his 70th birthday. It was at first intended to have a small party of his intimate friends at a hotel, but applications from far and wide came to the dinner committee, so that is was necessary to engage the opera house to accommodate the party, which numbered about 300. Such a gathering of eminent engineers and metallurgists has seldom been brought together in the United States. Soon after this Mr. Fritz retired from the active management of the company, and took the position of consulting engineer, which he held only a short time, retiring finally to enjoy the emoluments and honors of a busy and well spent life. In 1893 the Iron and Steel Institute of Great Britain conferred on him the Bessemer medal, and unanimously elected him an Honorary Member of the Institute, a distinction which has seldom been conferred, there being only six living who have received it.

Mr. Fritz became a member of the American Institute of Mining Engineers in 1872 and was elected to the Presidency of that Society in 1893. He has been a member of Mechanical Engineers since 1881 and was elected its President at the last annual meeting in November, 1895. He is also a member of the American Society of Civil Engineers.

Mr. Joseph D. Weeks, the President of the American Institute of Mining Engineers is a native of Massachusetts, and is now in his 55th year. His life work has been in the literary and theoretical rather than the practical side of engineering, and he has been identified with the iron trade of Pittsburg for nearly 25 years as a journalist and statistician. For the greater part of that time he has been the secretary of the Western Iron Association, for 10 years associate editor of the "Iron Age," and for 14 years editor of the "American Manufacturer and Iron World," which position he still holds. Outside of his regular work as editor of these papers, Mr. Weeks has devoted a great deal of time

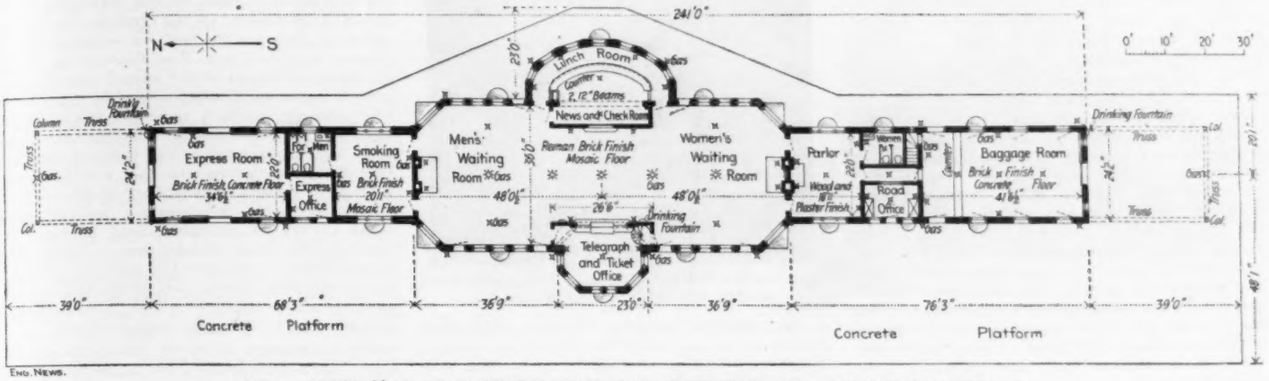
to statistical matters and to sociological investigations and writing. In 1880 he was selected by General Francis A. Walker, Superintendent of the Tenth Census, to make the investigation of labor and wages for that Census, and Vol. XX. of the report is devoted entirely to the result of his investigations. This report has received the unqualified approval of such authorities as General Walker and Edward Atkinson. Mr. Weeks also had entire charge of the collection of the statistics for the Census of 1880 of the manufacture of glass and coke, writing monographs which are to this day the only treatises on these subjects published in the United States. For the Census of 1890, in addition to having charge of the reports on the manufacture of glass and coke, he also prepared the reports on the production of crude petroleum, manganese and natural gas, and on the refining of petroleum in the United States, having in the meantime (1882) become the expert of the U. S. Geological Survey on petroleum, manganese, natural gas and the manufacture of coke, a position which he still holds, publishing yearly monographs on these subjects.

In 1878, just after the railway riots in this country, Mr. Weeks was selected by Governor Hartranft, of Pennsylvania, to visit Europe and make a report on the practical operations of arbitration and conciliation in the settling of labor disputes. His report on this subject is received in England as the authoritative history of this movement, and, with other reports which he has published on this subject, has done much to mold public opinion in favor of arbitration and conciliation as a means of settling disputes between employer and employed. In 1878 he was also one of the Pennsylvania Commissioners to the Paris Exposition. Mr. Weeks has recently made an exhaustive investigation into the statistics of taxation in Pennsylvania for the Pennsylvania Tax Conference, of which he is chairman. This conference is a voluntary body of 30 men, representing the great interests of the state, namely, agriculture, transportation, manufacturing and mining, trade and commerce, labor, and the County Commissioners, which, in Pennsylvania, constitute the assessing power.

Prof. Louis Duncan, Ph. D., President of the American Institute of Electrical Engineers, was born in 1862, and was educated at the United States Naval Academy, and at the Johns Hopkins University. He graduated at the United States Naval Academy in 1880 and went on a two-years' cruise, the greater part of the time being spent on the South Pacific and China Stations. In 1882 he was ordered to the Johns Hopkins University on special duty. In 1884 he was stationed at Philadelphia, at the International Electrical Exhibition held by the Franklin Institute. He was there made chairman of the committee which made competitive tests of dynamo electric machinery, and electric lamps. In 1885 he was given the degree of Ph.D. by the Johns Hopkins University, and in the fall of that year was ordered to sea by the Navy Department. In 1887 he was requested to organize a department of Applied Electricity at the Johns Hopkins University, and resigned from the Navy to accept the appointment of associate professor of electricity in that institution.

Dr. Duncan is the author of a number of papers which have appeared in the different magazines during the past few years. He was elected an honorary life member of the Franklin Institute, is a member of the Mathematical Society of France, and at the last annual meeting of the American Institute of Electrical Engineers, was elected President of that society.

In addition to his work at the Johns Hopkins University, Dr. Duncan has done a considerable amount of work in electrical engineering. Among other things, he with Mr. Frank J. Sprague, designed and built a 1,000 H. P. electric locomotive. He is at the present time acting as Electrical Engineer for the Baltimore & Ohio R. R. Co., in the installation of a plant designed to draw by electricity the trains of that system through the Baltimore Belt Ry. tunnel. He has also acted as engineer for the Baltimore traction syndicate, and for a number of other large electric railway corporations.



ENG. NEWS.

FIG. 2.—FLOOR PLAN OF PASSENGER STATION AT SPRINGFIELD, ILL.; CHICAGO & ALTON R. R.

THE MEDICAL ASPECT OF THE NICARAGUA CANAL.

The last report of the Surgeon-General of the U. S. Navy contains a report upon the medical aspect of the Nicaragua Canal, as made in 1895 by E. R. Stitt, Passed Assistant Surgeon, U. S. N., attached to the Nicaragua Canal Commission. As the conditions conducive or injurious to health on the route of the proposed ship canal would be of the greatest importance to all concerned in its construction—when that is actually undertaken—an abstract is here given for general information.

S n Stitt, after describing the topographical situation, commences with climatic and morbific conditions at Greytown, which he selects as undoubtedly the most healthy and suitable spot for the establishment of the general hospitals. Here the mean daily temperature rarely exceeds 80°, or falls below 75° F. in any month in the year. The prevailing exceedingly high relative humidity, associated with this heat, would appear to be peculiarly suited to the development of yellow fever; but he can find no record of this scourge having visited Greytown. He accounts for this immunity by the great regularity of the northeast trade winds, causing a constant change in the surrounding atmosphere; by the exceedingly porous nature of the coarse sand soil, which takes up the heaviest rain fall in an exceedingly short time and leaves the surface dry; by the absolute flatness of the site of the town, which allows the wind to reach every part and prevents the accumulation of miasmatic emanations, and by the degree and constancy of rainfall, making the constant use of rainwater for drinking possible, instead of any water from the ground.

Surgeon Stitt then takes up the "very accurate and complete" hospital records of the Nicaragua Canal Construction Co., covering the period between Nov. 1, 1889, and Dec. 31, 1890. In this period 1,666 patients were treated, of which 1,347 cases were medical and 322 surgical. Of these patients 1,646 were discharged cured and 23 died, giving a mortality of 1.3%. Of the 23 deaths, five were due to accidents or chronic diseases, six to diseases existing prior to entrance into the company's service, and 12 only to climatic factors. In 831 records of patients examined, 433 cases were due to intermittent fever and 203 to remittent. The latter usually disappeared in four or five days. Heavy rainfall increased the sickness about 7%, and this was notably the case when in the week April 30 to May 8, 1892, the rainfall was 35.42 ins. It is stated that laborers coming from Panama with the Chagres fever recovered from it after a stay in the hospital at Greytown, while all who returned to the Isthmus with this fever died there. From Dec. 31, 1890, to Dec. 31, 1891, 332 patients were treated at the hospitals, with a mortality of 1.87%, and only 0.93% died from climatic causes.

Regarding the susceptibility of different nationalities to climatic diseases, statistics show that the proportion between diseases due to other influences and those incident to climatic factors, was as follows: Jamaicans, as 1 to 5; Americans, 1 to 8 Nicaraguans, 1 to 7, and the inhabitants of 24 other countries, as 1 to 6. Surgeon Stitt says that the apparent greater immunity of the Jamaica negro is probably quite as much due to his aversion to labor as to any other cause. The European, by greater exertion and subsequent fatigue, induces greater susceptibility, and does not so quickly adapt himself to the mode of living in tropical countries.

Pure water supply is of the greatest importance in an enterprise of this kind in the Tropics. He says that no adequate provision had been made by the canal company for the collection and storage of rain water and at times it was necessary to resort to other sources. When examined chemically, the water of a surface well, on the Greytown side of the canal, showed organic matter and nitrates in large quantities, with traces of nitrates, sulphates and sulphides and considerable inorganic residue and the presence of infusoria. This water was a fruitful source of disease and the well had to be abandoned immediately. A well sunk on the other side of the canal, at quite a distance from contaminating sources, gave a chemical result of no organic matter and nitrates; no sulphides; a small amount of sodium chloride; traces of sulphates; no sulphides and magnesia present. The use of this water was followed by no bad results. But, says, the report, it is only fair to presume, that were there contaminating factors in the vicinity, the water would be as impure as the other and all ground water is regarded as suspicious and to be avoided by the inhabitants of Greytown.

The water of the Deseado River could be brought to Greytown in case of necessity, and this water is generally good now, though its quality may be impaired when excavation commences on the canal. The solution of the problem lies in storing rainfall. The annual precipitation at Greytown varies from 250 to 300 ins., and with a catchment basin of 100× 50 ft., not considering evaporation, the rainfall on this area would amount annually to about 700,000 gallons; or a ration of three gallons per day for 600 men.

On the western section of the canal the annual rainfall for 14 years has averaged 66.49 ins. with wide fluctuations. In 1885 it was only 34 ins., while it was 105 ins. in 1893. The months May to December are practically without rain, all the precipitation being in the remaining months, with the heaviest rainfall in June and October, at the sun's zenith. In August there is generally a period of dry weather, called by the nations the "veranillo." The term "invierno," or winter, is applied by the

people to the period between May and December, and the "verano," or summer season, to that between December and May.

The northeast trade winds, which bring rain to the Atlantic coast, invaribly bring dry weather to the west side, as the rain is all precipitated in passing the hills to the east.

On the west side the extreme temperatures range from 90° to 65° F. and daytime observations rarely exceed 85° or fall below 75°. The relative humidity, even during the dry season, is exceedingly high, ranging generally between 80° and 93°. As on the eastern side, malarial affections have predominated, usually of a hepatic type. With this type jaundice and hæmatemisis are generally present and it is frequently taken for yellow fever, and as the mortality from this cause, in the past two years, has been about 75%, there is little to chose between them. The remittant and intermittant fevers are mild, as a rule, and readily yield to treatment. Typhoid fever is almost unknown, but the entire lake regions is most inimical to the welfare of consumptives. Skin diseases are very common, eczema accounting for 75% of them.

Snakes are exceedingly rare on this line of the canal, only six varieties having been encountered during the canal's survey. The principal venomous snakes are the toboa, or toboba, the tamegas and the coral snake. The first is the Trigonocephalus, a pit viper, similar to the American rattlesnake, but without rattles. It is from 4 to 7 ft. long, with very strong intubated fangs from 1 to 3 ins. long, and they will penetrate either leather or canvas. The tamegas are smaller, but far more ferocious and equally venomous and are more dreaded by the natives than the toboba. There are several varieties of the coral snake and those with red and black bands alone are apt to be more poisonous than those with yellow bands and spots in addition. Among other animal life the report mentions the nigua, or "jigger," and the alligator ant as among the most annoying. Mosquitoes are only worse than those of the United States by reason of their greater abundance, while the bite of the scorpion is very painful but not dangerous.

Surgeon Stitt next discusses the probable effect of the work of excavating and dam construction upon health, in connection with the fact that railway and canal building has been productive of disease and death in other Central American States. So far no excavation has been done on the Nicaragua Canal, except by dredging, and the 10 or 12 miles of railway built was made by filling across a swamp with sand from the beach. When the work is pushed forward and the humus, so rich in organic matter, is exposed to the action of sun and rain, "the same conditions which were productive of fatal disease on the Isthmus of Panama will probably manifest themselves here." The immediate result of the construction of the canal will probably be to greatly increase the amount of malarial disease by reason of the great quantity of organic matter which will be undergoing decomposition in the newly-constructed embankments and dams. But this will be a temporary influence, and the final result will probably be beneficial by covering with water areas that are now simply pestilential swamps. The only possibility of the completed work directly causing disease in the future would be in case excessive rainfall or seismic force should destroy or injure the dams and allow the water to run off and thus expose vast tracts artificially covered.

Utah asphalt, used in laying pavements in Minneapolis, has succumbed to a temperature of 22°, says the "Tribune," of that city. This was the first test that this asphalt has had in so severe a climate, and cracks, ¼ in. wide and 2 ins. deep, are found in it, extending from curb to curb. The surfacing layer seems to be disintegrated under the influence of the cold. Mr. C. M. Carpenter, the Northwestern representative of the American Asphalt Co., says that his company will make good the damage. He charges much of the trouble as due to lack of softness in the mixture, in the attempt to make a pavement that would not mark under a hot sun, and to the employment of an inexperienced man at the roller on part of the work. The material had been allowed to become cool and set before it had sufficient compression. He pointed out that on the blocks where the mixture was richer and the rolling better, the cracks did not appear. City Engineer Cappelen is non-committal, and prefers to wait until the close of the winter before expressing a final opinion.

A NEW DESIGN OF MULTIPOLAR DYNAMO.

We illustrate herewith (Fig. 1) a new multipolar dynamo which has been quite recently put on the market by the Gates Electric Manufacturing Co., of Chicago, Ill., and which possesses noteworthy features in economical construction and operation. In designing this machine, attention was first turned to the problem of simplifying the pattern making. Where a separate pattern is required for each dynamo, as is the case in many designs of that machine, from 100 to 200 patterns are required to carry on an extensive business. The disadvantage of this

Fig. 1.—A New Multipolar Dynamo. Built by the Gates Electric Manufacturing Co., Chicago, Ill.

multiplication of patterns is evident, and it was decided to do away with it. After some study a design and pattern were made, which with very slight changes, such as the widening of a few parts, gave 18 different dynamos from one complete pattern. This is the first great claim made for the design of the dynamo illustrated. With five patterns the company is now manufacturing 99 different machines.

It will be noticed from Fig. 2, that the magnet ring can be entirely removed from the base casting, or that only the top half of the ring can be lifted off. The journal pedestals are also removable from the base. This construction allows the armature to be removed from the side or the top of the machine. Both the armature and the commutator are mounted on cast-iron sleeves separate from the shaft, permitting the use of the armature for either direct connected or belted machines. The shaft is forged steel and the shaft bearings are Ajax bronze metal.

In designing the field the comparative advantages of the different methods of constructing the poles were carefully considered. There are, generally speaking, two schools of designers in this particular. One school maintains that pole pieces built up of laminated iron and then cast into the magnet ring are the best form of construction, for the reason that the magnetic circuit is continuous and that laminated iron is more efficient than cast or wrought iron or low carbon steel. The other school claims that magnet blocks bolted to a cast iron or steel magnet ring, with pole shoes on the ends of the magnets, are preferable in many ways, as any individual magnet block with its field coil can be removed without disturbing the armature, and further, that the use of pole shoes on the magnet blocks overcomes armature reaction with less field charge than without pole shoes. It was considered by the designers of the Gates dynamo that the construction advocated by the first school was objectionable, (1) because the magnetic air gap is very great and the armature reaction not entirely overcome; (2) because it is almost impossible to cast the magnet ring around the pole pieces without leaving blow holes at the top of the pole piece; (3) the armature has to be removed or the top of the field casting raised in order to remove the field coil. The objection to the construction advocated by the second school is that there is a magnetic leakage owing to the joint between the magnet block and ring casting. The designers of the Gates dynamo considered this loss to be of less practical value than it was figured to be theoretically, and, moreover, they considered that users did not object to a small loss of efficiency providing they could get thereby a machine which could always be depended upon to run when wanted. The Gates dynamo was, therefore, constructed with open-hearth steel pole pieces bolted to the magnet ring. It will be noticed that the construction allows the field coil to be renewed or inspected without taking the machine apart.

The commutator is of the removable segment type. As is well known, the commutator is the part of the dynamo which causes most trouble, and the design was studied with the purpose of avoiding, if possible, the most common troubles. The usual trouble with commutators is that black spots are liable to occur in the individual bars, either from bad castings, lightning, or short circuits, and when this occurs with the ordinary commutator, either the commutator is ruined or necessitates a very heavy turning off to again get a smooth surface. With the usual style of commutator it is also difficult to prevent bars from raising when overheated. The Gates commutator is designed to do away with both these difficulties. With it, in case of injury from short circuit, lightning, or a bad bar,

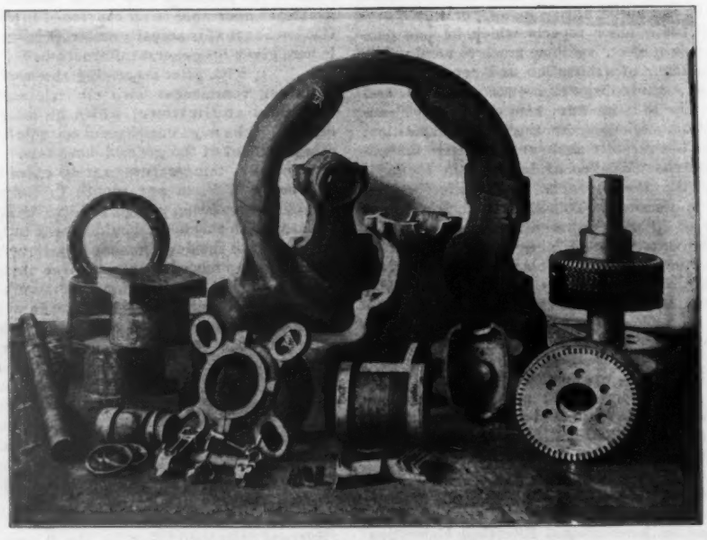


FIG. 2.—SEPARATE PARTS OF A GATES DYNAMO.

a commutator can be repaired in a very short time by taking out one, two, or more bars, and replacing them with new ones, and it is not necessary to turn down the whole commutator in order to get a smooth surface. Again, it is impossible when the commutator is abused and heavily overheated for the bars to raise.

The foregoing describes the more notable features of the machine illustrated. The aim of the de

signers has been to secure a machine of slow speed, high efficiency, convenient to handle and always ready to run. To this end especial attention is given to securing good material and workmanship in all parts.

A NEW FLY-WHEEL GOVERNOR FOR HIGH SPEED ENGINES.

A new form of fly-wheel governor has recently been brought out by The Brownell & Co., of Dayton, O., for use on their automatic engines. The advantages claimed for it are that the governor is mechanically locked in every position which it assumes, and can only be moved by the pull of the weights. The pull of the valve has no effect whatever, while, at the same time, the governor is free and certain to act, sensitive, strong and durable.

It has the usual arrangement of weights and springs, and belongs to that class of governors in which the eccentric swings from a fixed point, but instead of the eccentric being moved directly by the springs it is moved indirectly through the intervention of an auxiliary eccentric yoke. In the illustrations Fig. 1 is a view of the complete governor. Fig. 2 shows the main eccentric removed, with the pin bolted to it, which fits into the hole in the auxiliary eccentric yoke. Fig. 3 shows this auxiliary eccentric yoke and also the springs removed. As seen in Fig. 3 the weights are connected by links to the ears of the auxiliary eccentric, which is fitted to turn upon the hub of the governor wheel, so that as the weights are moved the auxiliary eccentric is turned around the shaft. This auxiliary eccentric is fitted with a yoke, or strap, which is shown in position in Fig. 2, and removed in Fig. 3. In this yoke is a hole which receives the pin bolted to the main eccentric in Fig. 2. Thus as the auxiliary eccentric is turned around the shaft, its yoke is thrown across, carrying with it the main eccentric, which is thus moved nearer to or farther from the center, thereby decreasing or increasing its throw.

To reverse the governor it is only necessary for the pin bolted to the main eccentric to be changed to the holes shown on the opposite side in Fig. 2, and for the weights and springs to be changed to the holes provided for them.

All wearing parts of the governor are circular in form, thus insuring smooth, uniform wear. The entire wear is taken up by two simple adjustments. The governor was designed and has been patented by Mr. H. C Clay, Superintendent of the Engineering Department of The Brownell & Co.

THE INCOME ACCOUNT OF RAILWAYS IN THE UNITED STATES FOR THE YEAR ENDING JUNE 30, 1895.

The Interstate Commerce Commission has just submitted a preliminary report upon the income and expenditures, for the year 1895, of 650 railways of the United States aggregating 164,529 miles of line. As the aggregate of operated mileage of the previous year was 175,691 miles, about 92% of the total mileage is represented in the present report.

For the mileage reporting, the total of gross earnings, for the year ending June 30, 1895, were $1,003,022,853; of which $293,465,792 was earned by the passenger department, including mail and express, and $683,022,988 by the freight service. The operating expenses for the same period were $677,667,635, leaving an income from operating of $325,355,218. The passenger service showed a decrease in earnings of $177 per mile of line as compared with the previous year, while the freight service shows an increase of $149 per mile of line. As the previous report showed a decrease in business of $904 per mile for the fiscal year of 1894, the Commission says that while the present report does not show that the country had entirely recovered from the general industrial depression of 1893-4, the last return warrants the conclusion that the downward turn has been arrested. The figures also show that the reduction in operating expenses, which usually follows rather than accompanies periods of depression, has been accomplished and no further sweeping reductions need be expected. In the fiscal year 1894 this reduction in expenses, as compared with 1893, amounted to $713 per mile of line; the reduction for 1895, as compared with 1894, was only $44 per mile.

In comparing the earnings and expenses by groups of State: group I, III and IX show the most marked gain; IV and VIII show a slight increase; II and V no marked change and the other groups show a decrease in net earnings.

The report again calls attention to the fact that the granting of dividends very imperfectly reflects the actual condition of corporate property; for the dividends involve the financial policy of management as well as the earning capacity of the lines. Thus, during the year ending June 30, 1895, the operating lines paid dividends amounting to $53,135,545; or $8,369,420 less in dividends than in 1894, while there was an actual increase of $5,217,548 in net earnings in 1895 over 1894. A study of the same figures by groups of States strengthens the impression that the amount of dividends paid in any particular year does not follow closely the earnings of that year.

The following comparative summary shows, for the whole United States, the proportion of earnings from operations, assignable to passenger and freight service, and the percentage of operating expenses to operating income:

	1895.	1894.
Earnings—from passengers, %	29.26	32.11
" from freight, %	68.10	65.49
" from other sources, %	2.61	2.38
" unclassified, %	.03	.02
Per cent. operating expenses were of operating income	67.56	68.14

This summary indicates a somewhat peculiar movement in railway traffic during the past two years. The ordinary course of statistics for the fiscal years 1893 and 1894 was disturbed in a very marked degree by the unusual passenger traffic incident to the Columbian Exposition. So far as the percentage of earnings from passenger service is concerned, the figures for 1895 seem to have returned to their normal proportions. This fact accounts for the relatively low per cent. of passenger earnings and relatively higher per cent. in freight earnings for 1895 as compared with 1894. Whether a permanent increase in passenger mileage will result from the unusually high record for 1893 can only be determined by future reports.

The relative costs of different illuminants is discussed by Dr. Wedding in the "Electro Zeitung." He estimates the cost of a 16 c. p. light produced by different systems and, on this standard, arranges them as follows in the order of cost for producing a given amount of light, the first being the cheapest: Electric arc lamp, gas burner with incandescent burner, petroleum, lamp, argand gas-burner, electric incandescent light, acetylene gas light.

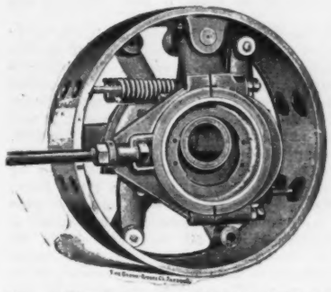


Fig. 1.—The Brownell Automatic Governor Complete.

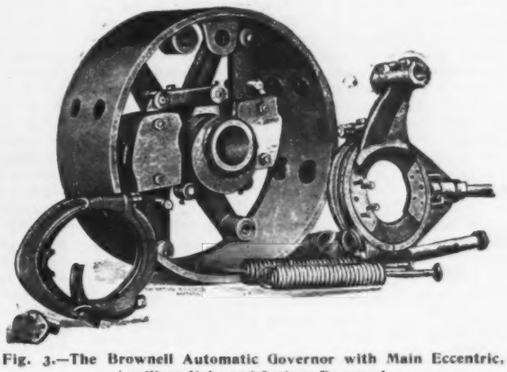


Fig. 3.—The Brownell Automatic Governor with Main Eccentric, Auxiliary Yoke and Springs Removed.

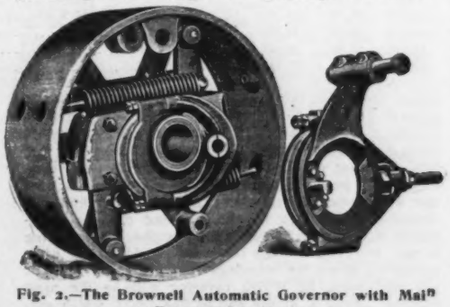


Fig. 2.—The Brownell Automatic Governor with Main Eccentric Removed.

PIPE-COVERING TESTS.*

By George M. Brill, M. Am. Soc. M. E.

Data may be found in several of the engineers' handbooks upon the condensation of steam in pipes covered with various materials, due to the radiation of heat into the surrounding air. Perhaps many of the materials mentioned in such tables were practicable enough at the time the experiments were made, when steam pressures were but a fraction of those carried now; but even the elaborate series reported in our own volumes of translations** might need revision to-day with the present requirements of pipe-coverings. Much of such data result from trials of small pipes and short lengths, and there is more or less given without a word of explanation regarding the conditions under which they were taken, making its value questionable. Also the wide range of materials, and the complicated mixtures used at present, prevent the making of any accurate deductions, even with full data concerning the values of the well-known non-conducting materials.

In view of these facts, it was decided by the Solvay Process Co. to make a series of tests of pipe-coverings, and determine the relative non-conducting values, compare original costs, saving due to covering, cost to apply, and from their physical and chemical compositions form some idea of durability, and, taking all the features into consideration, determine for ourselves, which is the most economical for general use. For the purposes of these tests about 60 ft. of standard 8-in. wrought iron pipe, coupled together in order to make it smooth and regular, was suspended where it could not be subjected to currents of air. In order to get the steam as dry as possible it was sent through a separator on its way to the test-pipe, and in the short connection between the separator and the pipe was placed a throttling calorimeter. The test-pipe had an inclination of 1 ft. in its entire length, which insured drainage of all the water of condensation to the lower end, at which point the receiver was connected, and into which the water gravitated as rapidly as formed. The water was measured in this receiver, which consisted of 4 ft. of 12-in. pipe, with graduated water-glasses attached near the top and bottom. The same volume of water was allowed to collect each time, was measured under the steam pressure, and blown from the receiver at the end of the run. A careful determination was made of the amount of water collected, by weighing the same volume while cold, and correcting for difference in weight due to the difference in temperature for the respective runs. These tests were made upon a scale large enough—in fact, upon a pipe of the size and length which is very common in the average power plant—with sufficient care, and in a manner to insure accuracy in the results obtained, and are consequently of some interest and value to all users of steam—the interests of the user, not the maker of pipe-covering, being of first importance in these tests.

The method of testing was to place a covering upon the body of the pipe in a workmanlike manner; put steam pressure upon the pipe for some time before commencing a run, thus being certain that the covering was thoroughly warmed, or dried, if put on wet; allow sufficient water to be formed to show at the zero mark on the receiver water-glass, and note time of beginning the run. As the steam was condensed and collected in the receiver, readings were taken at regular intervals of the temperatures in the room and calorimeter; the steam pressure was recorded on a Bristol gage and checked by a test gage; the temperature of the water in the receiver at the end of the run was obtained from five thermometers in ½-in.

*Abstract of a paper presented at the Detroit meeting of the American Society of Mechanical Engineers.

**Transactions of the American Society of Mechanical Engineers, Vol. II., Emery, p. 34, No. 21; Vols. V. and VI., Ordway, No. 135, No. 145, No. 164.

pipes of different lengths, reaching down from the top flange, so placed as to give the temperatures at five different points in the water. The run was ended and time noted when the water had risen 30 ins. in the receiver. The same method was followed in the case of every covering tested. Three runs were made with each, or more, if for any reason there was a marked difference in the period of time required to fill the receiver; thus each kind of covering was given the same opportunity to show its merits.

As stated above, the body of the pipe was covered with various material; the flanges at the ends, the receiver, and the connections between the separator and the test-pipe and between the pipe and the receiver were not covered. After finishing the tests of the coverings and the bare pipe, the flanges were removed from the test pipe, and without changing any of the connections to them they were bolted together, and pressure was thus put upon the connections, and through them and the flanges upon the receiver. The rate of condensation was thus determined for all the uncovered portions of the system, and formed a correction for the various runs, after determining the pounds of dry steam condensed per degree difference in temperature per minute. The slight variations in the steam pressures, room temperatures, and qualities of steam are all taken into consideration in working up the data, so that results are finally given upon a basis which enables direct comparisons to be made.

The following coverings were tested in the forms as usually applied to 8-in. pipe. Hair felt was tried, not only alone, but over another covering, to determine the saving due to the combination, and whether advisable to use it in this manner.

Name.	Sold By
Magnesia	Keasbey & Mattison, Ambler, Pa.
Rock Wool, New York Fire Proof Covering Co., New York.	
Mineral Wool, Seacord & Dodson, Batavia, N. Y.	
Asbestos Fire Felt, H. W. Johns Mfg. Co., New York	
Manville Sectional, Manville Covering Co., Milwaukee, Wis.	
Manville Wool Cement, Manville Covering C.. Milwaukee. Wis.	
Hair Felt, H. W. Miller & Sons, Philadelphia, Pa.	
Champion Mineral Wool, Chicago Fire Proof Covering Co., Chicago, Ill.	
Riley Cement, Riley Brothers, Troy, N. Y.	
Fossil Meal, Fossil Meal Co., New York.	

Average results computed from the log of tests are given in Table I.

There is little to prevent the wool from gradually working to the under side of the pipe, thus leaving but the thickness of the tubes to cover the upper portion, where, to be most efficient, the covering should be, if anything, a trifle thicker than on the under side. This action would surely be rapid, and disintegration certain, where any vibrations exist. Our experience leads us to think there is but little difference in the durability of Riley cement and fossil meal, and would class neither among the most durable; but upon that list would place the remaining ones, magnesia, fire felt, Manville sectional, and Manville wool cement, with little, if any, choice as to arrangement. The durability of hair felt is questionable, and depends largely upon the temperature to which it is subjected, and how thoroughly it can be protected from moisture. It would certainly need to be thoroughly covered and painted so as not to absorb moisture from the outside and thus become matted and soggy. It would be necessary to line it well with some non-combustible material to make it most efficient and durable.

It is not in the scope of this paper to determine or state the effects of the chemical components of the different coverings upon the pipe covered. The presence of sulphur in the best coverings, and its recognized injurious effects,* makes it imperative that moisture must be kept from the coverings, for if present, it will surely combine with the sulphur, thus making it active. This could be stated in other words—keep the pipes and covering in good repair. Much of the inefficiency of coverings is due to the lack of attention given them; they are often seen hanging loosely from the pipe which they are supposed to protect. The writer is thoroughly convinced that all coverings should be looked after at least once a year, and given necessary repairs, refitted to the pipe, and the spaces due to shrinkage taken up, for little can be expected from the best non-conductors if they are allowed to become saturated with water, or if air currents are permitted to circulate between them and the pipe. It would be interesting to know what chemical composition is most efficient, but the varying thicknesses in which the coverings tested are sold prevent any definite conclusions in that direction from this test, which in its intents is but a commercial one.

Mr. F. W. Taylor.—Upon the question as to what is, on the whole, the best covering to adopt, Mr. Brill has, I think, arrived at the same conclusion as did Professor Ordway, who made a very thorough and exhaustive course of tests some years ago, for the Massachusetts Institute of Technology. This conclusion was that hair felt, when put on the outside of another pipe covering, so as to be properly protected from close contact with the steam-pipe, is the best non-conductor and the cheapest covering to use in the long run. In arriving at a determination of which is the best covering to use, however, I think the chief consideration, after narrowing down the coverings that are really efficient non-conductors, is, Which covering will be the most durable? That is, at the end of five years, which covering will remain in the best repair, and will, at the end of that time, prove to be the best non-conductor? This question of durability, without requiring repairs or attention of any kind, is particularly important for most of our large manufacturing establishments, in which the cheap generation and use of steam is not one of the vital elements of the business, and in which the energy of the management has to be centered on the more intricate problems of how to manufacture cheaply and well. In such establishments, the managers usually want to settle, if possible, once for all such unimportant details as pipe covering, so as not to have to bother with them again for years to come. In experiments such as Mr. Brill's, this question of durability can, of course, not be thoroughly dealt with; it can, at best, be looked at from a partially theoretical standpoint. It is on this point that I have some practical data to present to the society.

After studying Prof. Ordway's experiments, some nine years ago, I arrived at the conclusion that the best solution of the pipe-covering problem lay in finding the proper material to insert between the pipe and hair felt, so as to prevent the latter from becoming charred under the action of heat. After about a year and a half of experimenting, I settled upon ¾ in. of fossil meal with 1 in. of hair felt outside of it, as, on the whole, the best. I found that neither ⅝ in. of asbestos felt nor ⅝ in. of fossil meal were sufficient to prevent hair felt from charring, but that ¾ in. of fossil meal would accomplish this object. Hair felt without any protection between it and the pipe would crumble away, where it came in close contact with the top of the pipe, in about three years, and long before this time the lower part of the hair felt would sag away from the pipe, so as to leave an air space between it and the pipe, which of course, would ruin its value as a pipe covering.

My reason for going into the question of pipe covering so thoroughly at this time was that I was then chief engineer of the Midvale Steel Co., and they were about to put in a new main steam-pipe, the old pipe being entirely abandoned, and a very much larger one being substituted throughout the works. This pipe when it was put in was unusually large, starting at 24 ins. diameter and gradually reducing as it progressed throughout the works, until it finally was only about 6 ins. in diameter. It was suspended from the roofs of the buildings by long rods, so that it was practically free to expand and contract. This pipe was covered throughout with the following covering: (1) Fossil meal, ¾ in. thick; (2) A layer of hair felt 1 in. thick; (3) A layer of resin-sized paper was tightly bound with twine on the outside of the hair felt; (4) A covering of canvas sewed together outside of the resin-sized paper; (5) This canvas, thoroughly painted with two coats of iron oxide paint, and this was by no means the least important of the elements of the covering.

A few days since, while in Philadelphia, I examined this covering at intervals throughout its length, and found it, after being used for 7½ years, in an extraordinarily good state of preservation. In fact, for serving its purpose as a pipe-covering it appeared to be as good as new. I did not find a single place in which I could detect that the fossil meal had been jarred loose from the pipe, nor could I satisfy myself that the hair felt had in any case sagged away from the fossil meal at the bottom of the pipe. The pipe throughout a great part of its length was subject to an extraordinary amount of jarring and vibration, as it ran through the center of a large hammer shop containing ten steam hammers. This is surely a severe test for any form of pipe-covering, and I think it conclusively shows that fossil meal, when properly put on, is an admirable material to resist jar. I would here particularly call attention to the desirability of thoroughly painting the canvas where it is to be subject to the action of furnace gases, since unpainted canvas, when used in this same hammer-shop and rolling-mills, and subject to the action of the furnace gases, will last only from six months to a year.

Prof. R. C. Carpenter.—I wish to call attention to one fact that I think has not been brought out. You will notice that the thickness of these coverings varies very greatly. I tested the same kind of covering, as in these experiments gives the highest efficiency, except that it was less than an inch in thickness, and obtained, practically, twice the condensation shown in this paper; with coverings of the same thickness as recorded by Mr. Brill, the results were the same as his.

Mr. George M. Brill.—That the coverings tested were far from uniform thickness is to be kept in mind in attempting to make any deductions for scientific purposes.

Kinds of Covering.	Thickness of Covering, ins.	Dif. in Temperature of Steam and Air.	Length of Run.	Dry Steam, Condensed, Lbs Av. of Runs. By Receiver and Connections.	Total.	By Radiation Through Covering.	Per Hour Through Covered Pipe.
Bare Pipe	1.25	268.8	51.5	9.84	106.79	96.95	112.951
Magnesia	1.25	277.8	231.7	45.75	109.69	63.94	16.558
Rock Wool	1.60	281.1	285.3	57.00	110.27	53.27	11.203
Mineral Wool	1.30	285.8	264.7	53.77	109.50	55.73	12.632
Fire Felt	1.30	265.7	205.0	38.90	109.79	70.89	20.748
Manville Sectional	1.70	267.2	254.7	48.37	110.03	61.66	14.525
Manville Sec. and Hair Felt	2.40	272.9	322.0	62.46	110.76	48.30	9.000
Manville Wool Cement	2.20	262.7	260.7	48.18	109.84	61.16	14.076
Champion Mineral Wool	1.44	271.8	262.3	50.67	109.19	58.52	13.386
Hair Felt	.82	279.3	217.7	43.22	109.89	66.67	18.375
Riley Cement	.75	273.6	123.7	24.05	107.84	83.79	40.641
Fossil Meal	.75	271.8	133.0	25.69	108.19	82.50	37.218

Kinds of Covering.	Lbs. Steam Con. per Sq. ft. per Hour. Actual.	B. T. U. Transmitted per Hour. Sq. Ft. of Pipe. Act. Conds.	Sq. Ft. of Pipe per Deg. Dif. in Temp.	Per Sq. Ft. Pipe. Av. Conds.	Lbs. Steam Cond'sed per Sq. Ft. per Hour Average.
Bare Pipe	8.342	727.439	2.7059	736.846	.8458
Magnesia	.1223	106.609	.3838	104.470	.1200
Rock Wool	.0827	72.090	.2556	69.819	.0802
Mineral Wool	.0933	81.330	.2846	77.468	.0890
Fire Felt	.1532	133.468	.5023	136.726	.1570
Manville Sectional	.1073	93.415	.3496	95.161	.1093
Manville Sectional and Hair Felt	.0664	57.841	.2119	57.679	.0662
Manville Wool Cement	.1039	90.580	.3448	93.855	.1078
Champion Mineral Wool	.0989	86.093	.3166	86.179	.0990
Hair Felt	.1357	117.869	.4220	114.868	.1319
Riley Cement	.3001	260.757	.9531	259.484	.2979
Fossil Meal	.2747	238.824	.8787	239.182	.2747

Table II shows (1) the pounds of steam condensed per sq. ft. of pipe surface per hour through the coverings as tested, with the slightly differing steam pressures and qualities, and room temperatures considered; (2) B. T. U. lost per hour per sq. ft. of pipe surface; (3) the same, per degree difference in temperature. Having reached a basis upon which to make comparisons, shows (4) the B. T. U. lost per hour per sq. ft. of pipe for the average differences in temperature of steam and room; (5) the lbs. of steam condensed per hour per sq. ft. of pipe. The last three columns and all the results following are directly comparable.

Concerning durability, it is difficult to make any definite determinations showing relative values, since so many elements must be considered. We could determine the action of high temperatures for a short period, but in practice the element of time enters, and brings changes of temperature and the consequent contractions and expansions. Moisture, vibrations, acids and alkalies, also work against the life and efficiency of any covering. It is largely due to their physical composition that some are more durable than others; the effects of chemical composition and of physical composition to some extent, together with the thickness, are involved in the non-conducting properties.

We noticed a tendency to sag in both makes of mineral wool and the rock wool. From the nature of the material and the way it was necessarily made up, in practically two concentric tubes, it is difficult to prevent its sagging and getting in a bad and inefficient condition.

*See transactions A. S. M. E., Vol. III., Hutton, No. 72.

(As being of interest in this connection we print below the abstract of a paper delivered by Mr. John A. McConnell before the Engineers' Society

of Western Pennsylvania, at the meeting of Sept. 19.—Ed.)

The great difference between the amount of heat received from the sun by different parts of the earth at different seasons, and also the important offices performed by artificial heat, make the insulation of heat an important function in the economy of nature and a constantly-recurring question in the every-day operations of men. The earth would be uninhabitable if the envelope of air by which it is surrounded were not a poor conductor of heat. The earth's surface is a porous formation, thus making it also a poor conductor, and this property of the soil performs an important function in preventing the roots of vegetation from freezing.

The use of good heat-insulating materials in buildings has been very largely overlooked. In new countries fuel is usually abundant, and hence, under the conditions first prevailing, it was easier to furnish fuel to make big fires than to build houses that would confine the heat, and this barbarous custom has survived to a surprising extent. We to-day build most of our residences with the full knowledge that, with the thermometer at zero on the outside, it will very soon be zero inside in the absence of fires. I believe it perfectly practicable and much more economical to so construct houses that extremes can easily be avoided both winter and summer.

The first attempts at insulating steam-heated surfaces consisted in covering them with the same kind of materials as are used by mankind for clothing. It was soon found that when animal or vegetable fiber was applied directly to such surface, the heat gradually charred and destroyed it, and this led to the introduction and use of mineral substances exclusively, many patents being taken out on various applications of clays, lime, etc. These proved unsatisfactory, and the next step was the mixing of hair and vegetable substances with these minerals. This was a great improvement, but such compounds were far from indestructible, and the need of a substance that would not burn caused resort to asbestos, and a half-hundred or more patents were taken out in this country on different combinations of asbestos cement alone. The next step was the plan of John Ashcroft of forming an air space next to the hot surface. This space, while it adds to the permanency of asbestos cement work, is not so good a non-conductor as is generally supposed, 1 in. of air being to an inch of hair-felt about as 13 to 100. The principal office of air-strata, or cells, is to interrupt the heat flow, and very small strata, or cells, do this almost as efficiently as those of great thickness.

The bulk of all that has been written about heat-insulating coverings has been in relation to their non-conducting power, and little attention has been given to the question of permanency. In addition to many commercial tests, experiments have been carried out in the engineering department of a number of our leading colleges to determine the heat-insulating power of different classes of covering, and the results announced have been very conflicting. Most of the tests have been by condensation, substantially as follows: From the main pipe branch a number of smaller pipes of the same size and length, each insulated with a different covering. The free end of each pipe is lower than the main, and the water is drained from each and weighed to determine the relative condensation in a specified time, the condensation in the main pipe being drained off separately. A carefully-conducted test at the University of Michigan, under the direction of Professor Cooley, showed the superiority of hair-felt; a similar test at Pennsylvania State College showed mineral wool to be the best non-conductor, and I have been informed that a test at Cornell University showed wool-felt, lined with asbestos paper, in a favorable light. The results of all these experiments, coupled with my own experience with 25 or 30 different varieties of material, convince me that coverings can be made either of hair, wool, asbestos, wood-pulp, mineral wool, infusorial earth, carbonate of magnesia, chalk, gypsum, and compounds of these and other materials, which will all be so nearly alike in non-conducting power that a slight change of condition will turn the scale for or against any one of them.

Porousness is one of the necessary qualities of good non-conductors, and this quality necessarily tends to weakness, hence clothing for steam pipes, like the clothing we wear, is liable to wear out. Means for counteracting this natural weakness and for making coverings permanent is the one thing now needed. I am thoroughly convinced that there is only one practicable way of rendering coverings really permanent, and that is to strengthen them by reinforcing with iron. Iron can be so incorporated in the body of the covering that the atmosphere cannot reach it, and the life of iron thus protected is almost unlimited. Thus situated it will hold the covering in place indefinitely, making it really permanent. A high degree of permanency is attained by using an inch thickness of any of the well-known mineral coverings, and outside of this from a half-inch to an inch of wool felt paper, made into solid tubes and securely fastened over the mineral coverings. Felt paper pipe coverings, while excellent non-conductors, have heretofore failed of permanency because they were placed so near the hot pipes that they gradually burned up. With an inch of good mineral insulation next to the pipe, this charring weakness of the felt paper is entirely overcome, and, the paper tubes being very strong, will, if properly fastened, hold the magnesia, asbestos, or other mineral covering securely in place. Less than an inch of mineral under the paper will not protect it, hence this plan means substantially two coverings and an increased cost. I do not believe it is possible, however, to make heat-insulating coverings permanent without making the first cost more than it has heretofore been.

Discussion.

Mr. Emil Swensson: It may be of interest to our members to give a brief description of the heat-insulating covering of the large steam pipe line which carries the steam supply of the Keystone Bridge Works from the Lucy Furnaces across the furnace stock yards and the A. V. R. R. tracks to and over the buildings of the bridge works. This line is composed of about 600 ft. of 14-in. pipe and about 300 ft. of 10-in. pipe, and is exposed to wind and weather throughout its entire length. On account of the great height at which it is carried, it was decided to support the pipe from below, rather than hang it up, as is usually done; but how to do this and at the same time accommodate the expansion and not interfere with or break the necessary insulating covering, became a serious problem. To permit a free expansive movement, it was decided to support the pipe in cast iron shoes resting on roller nests. But, of course, the shoes could not come in direct contact with the pipe without breaking the covering, the insulating materials being of a very porous nature, and consequently having small resistance to crushing. An experiment was made to test the strength of asbestos cement and its various modes of application, suitable on this line. A section 5 ft. long of the 14-in. pipe was covered in three different ways, first, similarly to the proposed covering for the entire pipe line, consisting of an air-space of 1½ ins., having five tin thimbles or studs to the sq. ft., which held a heavy wire netting away from the pipe; over the top of this was applied 2 ins. of asbestos cement in four coats. The second method was the same as the first, except that wrought iron gas pipe was used instead of tin for the thimbles at the saddle rest, for a space of about 15 × 18 ins. The third was similar to the first, except that the air space for a width of 15 ins. all around the pipe was filled in solidly with cement mixed on asbestos. A saddle or shoe 12 ins. square was placed on the various kinds of covering and loaded until the cement began crushing in. I do not now remember the different loads used in the first two arrangements, but I do remember that the first ones were both too weak, the first one being the weakest. The third showed ample strength for our purpose, carrying a load of 3,200 lbs. without showing sign of crushing. As the load to be carried was about 1,000 lbs., and as the size of the shoe would be about 15 × 18 ins., the safety factor would be ample, especially after hardening of the cement. This last described method of construction was consequently decided upon as the one to be used at the saddles. After the asbestos cement had been put on, it was covered with canvas, sewed all around the pipe, then painted with white lead, and finally the upper two-thirds of the pipe was covered with No. 24 gage sheet iron, wired on and painted with oxide of iron. The covering has now been on for three years, and is in as good condition as when first put on. Its value as a heat insulator is best illustrated by the fact that when the uncovered pipe will burn the hand, the heat can barely be detected on the outside of the covering.

LEGAL DECISIONS OF INTEREST TO ENGINEERS.

Power of City to Enforce Sewer Assessments.

The charter of Indianapolis (Acts 1891), authorized the city to exercise the power of eminent domain, and to provide upon what terms real estate might be drained, and declared that, when a sewer was intended and adapted only for local use of property owners adjoining the street in which it was built, its cost should be paid by the abutting owners. It was held that the city had power to construct a sewer in the street in front of one's land and assess his land therefor, though he received no benefit from it, and had previously been assessed for a sewer in the rear of his lot. The necessity for a sewer is a matter to be determined by the municipal officers, and unless there has been an abuse of discretion, the courts cannot interfere, even though the officers have erred in judgment.—Coburn v. Bossert (Appell. Ct. of Ind.), 40 N. E. Rep. 281.

Liability for Explosion of Gases in Sewer

In an action against a city for damage caused by the explosion of a public sewer, it appeared that petroleum which had been allowed to run into the sewer under the direction of the chief of the city's fire department could not flow out by reason of the high water in the river at the outlet of the sewer; that it was in the sewer for four days, and generated gases, which could not escape because the manholes were kept closed; and that the gases were accidentally ignited, causing the explosion. It was held that the question of the city's negligence was for the jury.—Fuchs v. City of St. Louis (Supr. Ct. of Mo. Div. No. 1), 31 S. W. Rep. 115.

Power of City to Construct Water Works.

The power to construct a water-works system for a city is not a necessary incident of its incorporation, but must, like all its other powers, be derived directly form the legislature of the state; and the power "to construct and maintain" such a system implies a duty of the municipality, through its corporate authorities, to maintain and preserve possession for the benefit of the public. When a municipality is vested by its charter with power to construct and maintain a system of water-works at the public expense and for the public use, and accepts such charter, and proceeds to exercise this authority in the manner designated, by the construction and maintenance of such water-works at the expense of the citizens of the municipality, the water-works so constructed and maintained are clothed with a public trust and are devoted to public use.—Huron Water-works Co., v. City of Huron (Supr. Ct. of S. D.) 62 N. W. Rep. 975.

Liability of Water Companies.

A water company is not liable to the owner of private property destroyed by fire through failure to furnish water to extinguish fires under a contract between itself and a city.—House v. Houston Water-works Co. (Supr. Ct. of Tex.), 31 S. W. Rep. 179.

Speed of Street Cars.

Where the ordinance granting franchises to street cars does not specify the rate of speed, then they are to be governed by the ordinances of the city regulating the speed of vehicles on the streets.—Bly v. Nashua St. Ry. Co. (Supr. Ct. of N. H.), 32 Atl. Rep. 764.

Grade Crossing by Electric Railway.

The Supreme Court of Errors of Connecticut has decided that the legislature may authorize an electric street railway company to cross at grade a steam railway, along a highway, without providing compensation for the injury to the railway which may be thereby caused.—N. Y., N. H. & H. R. Co. v. Bridgeport Trac. Co. (Supr. Ct. of Errors, Conn.), 32 Atl. Rep. 953.

Negligent Grading and Curbing of Streets.

A city is liable for damages to an abutting property owner for the flooding of his cellar and undermining of the walls of his building, caused by its negligence in grading and curbing the street and sidewalk, but not if the work was properly done and the injury was one necessarily incident to the property, owing to its location and the wet and marshy condition of the land.—Benson v. Wilmington (Supr. Ct. Del.), 32 Atl. Rep. 1,047.

Paying Twice for Damage to Property.

After an elevated railway had been erected in a street without compensation to the owner of abutting property, and the owner had sued to recover damages, he conveyed the premises, reserving by a separate instrument which was not recorded, the right to all damages which had accrued or should accrue by reason of such interference. His grantee conveyed the land to another party, without knowledge of the attempted reservation, and subsequently the original grantor compromised his suit and released the elevated railway company from all claims by reason of the construction of the road. Held, that such release did not relate back to the date of the attempted reservation and show an extinguishment of the easement in the street, so as to defeat a claim by the present owner of the abutting property for injuries thereto.—Foote v. Metropolitan El. Ry. Co. (Ct. of App. of N. Y.) 42 N. E. Rep. 181.

What Must be Shown to Secure Preliminary Injunction Against Railway.

A person whose land is subject to the servitude of a public highway is not entitled to a preliminary injunction to restrain the construction of an electric railway on such highway, merely because the company is proceeding without legal authority, but he must show, either that the proposed road will impose an additional servitude on his land, or that he will suffer some special injury—Borden v. Electric Ry. Co. (N. J. Ct. Chan.), 33 Atl. Rep. 276.

When City is Not Liable for Defective Streets.

Where the construction ad maintenance of water-works of a city are vested by statute in an independent commission, the city will not be liable for injuries from defects in the street due to negligence of its own, or the servants employed by the commission, in laying the pipes.—Gross v. City of Portsmouth (Supr. Ct. of N. H.), 33 Atl. Rep. 256.

Indebtedness in Excess of Revenue Void.

When a statute provides that a city shall not incur liabilities in any year in excess of the revenue of that year without the consent of two-thirds of the qualified voters, a levy and assessment for liabilities so incurred is void. And where a levy and assessment for payment of a claim against a city is invalid, one for payment of a judgment on such claim will also be invalid.—Smith v. Broderick (Supr. Ct., Cal.), 40 Pac. Rep. 1,033.

Injunction Will Not Prevent Removal of Nuisance.

The city authorities cannot be enjoined from removing an awning placed over a sidewalk, where the awning was not constructed in conformity with the ordinances of the city. The fact that such awning has been maintained for more than 20 years does not give a prescriptive right to its continuance. Public officials cannot be enjoined from performing the duties incumbent upon them by law.—Simis v. Brookfield (Supr. Ct., N. Y.), 34 N. Y. S. Rep. 695.

Garnishment of Municipal Corporation.

A municipal corporation is not subject to be garnished for money due by it to a contractor for constructing a sewer or other public work, although such work had been fully completed before the time when the garnishment was served, and the indebtedness of the municipality was for the balance then due the contractor. Public policy requires that such corporations shall be exempt from the process of garnishment.—Leake v. Lacey (Supr. Ct. of Ga.), 22 S. E. Rep. 655.

Consent of Property Owners Not Requisite.

Although a statute may provide that no street railway shall be constructed without first obtaining the consent of the owners of one-half of the value of the property abutting on the street, it does not require such consent where the company is going to use tracks of another company, already constructed.—Ingersoll v. Nassau Elec. Ry. Co. (Supr. Ct., 2nd Dept.), 34 N. Y. S. Rep 1,044.

ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

Published every Thursday at Tribune Building, New York. Entered at the Post Office, New York, as Second Class Matter.

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ALFRED E. KORNFELL, New York..... } ADVERTISING
F. A. PECKHAM, Chicago..... } REPRESENTATIVES.

PUBLICATION OFFICE.....Tribune Building, New York.
CHICAGO OFFICE.....1636 The Monadnock.
LONDON AGENCIES: { KEGAN PAUL, TRENCH, TRUEBNER & CO. (Limited), Paternoster House, Charing Cross Road; SAMPSON LOW, MARSTON & CO., (Limited), St. Dunstan's House, Fetter Lane.

SUBSCRIPTION RATES: United States, Canada and Mexico, One Year, $5.00; 6 months, $2.50; 2 months, $1.00; Single copies, 15 cents. To all other countries in the Postal Union, add $2.08 per annum (4 cents per number) to above prices for postage. No club rates allowed. Mailing addresses may be changed at will by sending both old and new address. We shall be obliged if subscribers, who fail to receive their papers promptly, will notify us without delay. The date when the subscription expires is on the address label on each paper: the change of this to a subsequent date is the only receipt sent, unless by special request.

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The failure of the masonry water tower at Lena, Ill., which is described on another page of this issue, is another illustration of the danger of laying masonry with natural cement mortar during freezing weather. Nearly every experiment that has been made, and some of them have been very elaborate, has shown that if a green mortar of natural cement be frozen, it will disintegrate to a greater or less degree upon being thawed. It seems to us that no further explanation of the cause of the accident at Lena is needed. Whatever action the wind and rain had, was simply the mechanical action of washing out the mortar which had crumbled in the joints after being thawed. Neither do we think it likely that if the mortar had stood longer without thawing it would have gradually hardened into full strength. The least length of time any part of the mortar stood without thawing was 10 days, and probably the most of it had stood twice that time; if it had not developed hardness enough to resist the abrasion of the wind and rain at that age, it does not seem likely that it would have ever have gained the strength which it should have for the important duty it was called upon to fulfil. The builders should congratulate themselves that the accident occurred before the tank had been placed and more serious damage was possible.

Engineer-Inspector is a new classification introduced into the Civil Service lists of New York City through the efforts of prominent civil engineers now connected with the Department of Public Works. The purpose seems to be two-fold, as near as can be learned. The first is to enlist in the inspection service of the city bright young men, with some engineering experience and knowledge, as a substitute for the average inspector under existing practice. And the second purpose is to establish a practical school of municipal engineering under conditions that are likely to attract the class of young men really wanted. These Engineer-Inspectors would be available in all branches of the Department of Public Works, and the experience to be gained would extend from street opening and grading, through sewer construction and pipe-laying, to the finished street pavement. The innovation seems an excellent one. Under past methods the position of inspector in the Public Works Department has been chiefly looked upon as a favorite means of rewarding personal political service, and efficiency for the duties to be performed received a minimum consideration. The result of this method of appointment is too notorious to be further commented upon. The chief qualifications for an inspector are intelligence, honesty and alertness; and when these qualities are coupled with engineering training and experience, as in the new class proposed, the interests of the city would certainly be in safer hands than under the older practice. From an educational point of view the position holds out especial inducements to the young engineer in giving him experience in the methods of municipal work under rare conditions; and the knowledge thus gained must and undoubtedly will be duly considered in connection with the pay received. It is practically the extension to city work of a system long ago most successfully introduced upon the Pennsylvania Railroad; where young engineers are now made supervisors of track, etc., instead of placing old trackman in these positions as was the former custom.

The liability of failure of the simple manual block system, due to the fallibility of human nature, has been shown again by a serious rear collision, caused by a sleepy signalman, which occurred on the night of Dec. 31, in the tunnel of the Terminal Railroad Association of St. Louis. The tunnel is 5,100 ft. long, extending from Clark Ave. to Washington Ave., and all the heavy traffic between the Union Station and the Eads' bridge passes through it. This tunnel forms a single block and has a signal tower and signals at each end, with telegraphic communication between the towers. The man in the tower at the Washington Ave. end went to sleep about the time when a Wabash R. R. train was due, and on waking he came to the conclusion that the train must have passed his tower, and he therefore telegraphed to the other signalman that the train had passed, giving the time at which it had passed, making a guess at this, of course, in order to conceal his dereliction from duty. As a matter of fact, however, the Wabash R. R. train had stopped in the tunnel for a few minutes to allow of rectifying some slight defect in the air brakes. The man in the Clark Ave. tower having been notified that the train had passed out of the block, lowered his signal to admit a Vandalia Line train, which ran into the Wabash R. R. train, smashing the rear sleeping car. The fireman on the Vandalia engine was killed. The accident is regrettable, not only on account of its disastrous result, but also on account of the distrust of the efficiency of the block system which it will undoubtedly cause in the minds of persons not fully informed as to the principles of this system. The use of the controlled-manual block system, with track circuit, which would prevent a signalman from giving a clear signal when the block was occupied, is specially adapted to lines of busy traffic. It is reported that an automatic system was tried at one time at St. Louis, but failed, owing to the dampness of the tunnel causing the apparatus to be frequently out of order. The advisability of purely automatic signals on such a busy and dangerous piece of line may be doubted, but the use of the manual-controlled system with track circuits in the long and busy four-track Harlem tunnel of the New York Central R. R. at New York, is sufficient proof that this system can be operated with success in a tunnel having very heavy traffic.

The sleeping of signalmen while on duty is a more frequent occurrence than is generally supposed, and under the general system of discipline is usually punished by discharge, being looked upon pretty much as a crime. The first impulse of a man on awakening is naturally, therefore, to take reckless chances in an attempt to prevent discovery. As noted in the article on "A Railway Division and Its Work," in our issue of Jan. 9, this may turn out all right in ninety-nine cases out of a hundred, but in the hundredth case it may cause disaster. The St. Louis accident was one of the hundredth cases. The most careful and reliable men are likely to succumb at times to the influences of sleep, even under circumstances of personal danger to themselves, and especially under the sleep-inducing influences of a night shift in a warm signal tower. In this particular case the man is said to have been careful, temperate and trustworthy. Had he known that he would only receive a reprimand or reasonable punishment in case his fault was confessed or became known by a slight delay to the trains, he would have probably taken some pains to ascertain whether the expected train had or had not passed during the time he was unconscious. As described in the article above referred to, the liability of signalmen to fall asleep is semi-officially recognized on the Erie R. R., and the men are cautioned not to attempt to handle the levers until they are fully awake and understand the state of train movements, detentions to trains being far less serious than accidents. In this connection reference may be made to a recent accident on the Brooklyn Bridge, where a switchman (admitted to have been a careful man), momentarily careless in his anxiety to be prompt, moved a switch too soon and derailed the rear truck of the last car of a train. For this he was discharged, although the new man was probably just as liable to make the same mistake. All the responsibility should not be thrown upon this man, but should be shared by the management in not providing a detector bar or other preventive device at a switch where such a mishap is imminent hundreds of times every day. We are informed that detector bars were used at one time but were given up on account of the amount of work in keeping them in order and taking up the wear, but it would seem no impossible task to devise a reliable and efficient appliance. These two accidents are only examples of the fallibility of the human brain and the danger of putting absolute trust and responsibility on human action.

In illustrating and describing the new air compressing and pumping plant for the Ocean Grove water-works on pp. 22 and 23 of our last issue, we omitted to state that the credit for the design and construction of this unique plant is due to the Ingersoll-Sergeant Drill Co., of New York city. It is one of the standing rules of this journal to give credit in all cases where credit is due, and any omission to do so is due to accident or inadvertence.

THE EXPERIENCE OF RECENT GRADUATES FROM ENGINEERING SCHOOLS.

There is probably no question which possesses quite so much interest to the student in an engineering school during the last year or two of his course as his prospects for obtaining employment in the line of his profession after graduation. This is especially the case if he is borrowing money or drawing heavily on slim family resources to pay for his engineering education, and this description applies, we believe, to a very considerable proportion of engineering graduates. The literature of engineering is filled with statistics on every conceivable subject of professional importance; but on the highly interesting question of the success and remuneration of the young engineering graduate, the first statistics, so far as we are aware, ever published have just come to our notice in a paper in the current number of the "Engineering Magazine."

This paper has the suggestive title, "Are We Educating Too Many Electricians?" and its author details the results of a personal investigation of the success attained by recent engineering graduates as follows:

Feeling sure of the over-production of electrical engineers, and in order to secure some facts as a verification of my convictions, I sent 260 personal letters to the graduates in 1895 in electrical, mechanical and civil engineering from Cornell and Lehigh Universities and the Massachusetts Institute of Technology. The letters were sent in the latter half of September. My idea was to secure statements which would show comparatively the number of positions secured by recent graduates in electrical, mechanical and civil engineering courses, to ascertain whether influence was necessary to secure positions, and, finally, to determine the salaries paid in these positions.

While statistics on these points might not prove anything, they would be a strong indication of probabilities. Of course, it would be more interesting, and possibly more valuable, to have these questions answered by men who graduated from college 10 or 15 years ago, and are well established in the line of work in which they will probably spend the remainder of their lives; but the impossibility of securing such information will be recognized, as men farther advanced in years have much more hesitancy about informing others as to their salaries and occupations.

The letter stated, in brief, that I desired to secure statements from recent graduates in reply to the following questions, the answers to which would be considered confidential:

1. Have you secured a position in the line of engineering since graduation?
2. Was this position secured through any relative?
3. Was this position secured through the influence of friends?

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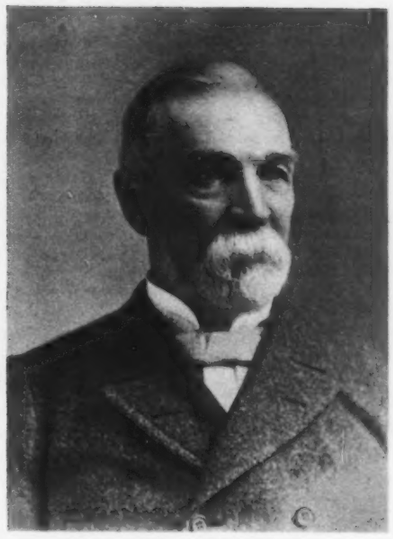
President of the American Society of Civil Engineers.



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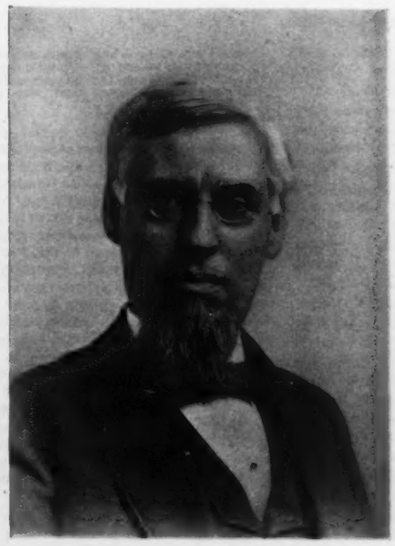

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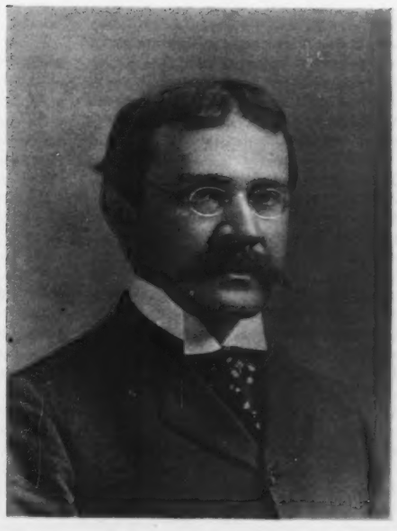


President of the American Institute of Electrical Engineers.

THE PRESIDENTS OF FOUR AMERICAN ENGINEERING SOCIETIES

4. Of what does the work you are doing consist?
5. How many hours per day are you employed?
6. What salary do you earn per week?

The replies received were most interesting, courteous and complete. They gave one an opportunity of becoming acquainted with and an insight into the character of some of America's recent and representative graduates in engineering, and the letters would prove valuable and instructive food for consideration by college professors. For example, the letters written by the graduates of one college were particularly noticeable as indicating their author's lack of training in the use of good English. A number of the letters would make very interesting and helpful reading for young men about to enter the practical life of an electrical engineer. With the consent of the writers, I print extracts from two letters received from graduates in electrical engineering:

I have made application by letter to about 100 of the leading manufacturing and railway companies, consulting and contracting engineers, etc. Although more than one-half the letters sent have received kind attention and have been acknowledged, yet, from statements such as this, "Our engineering force is now filled and more so," I cannot but think that most of the positions secured must have been created through the influence of relatives or friends.

After graduation, I wrote a number of letters applying for a position, but received discouraging replies. In these letters I mentioned nothing of shorthand and German. What I wanted was a start in engineering work; this is very difficult, as I know from my own case. I then wrote two more letters, in which, among other things, I mentioned my knowledge of shorthand and German, and also stated that I had had some experience in business. Both of these letters brought answers asking an interview. As a result, I have my present position. I believe that technical graduates could more easily obtain positions, if they had something else to recommend them, in addition to their engineering education. Perhaps I would not have a position now, if it were not for my other acquirements.

THE EXPERIENCE OF RECENT GRADUATES OF THREE ENGINEERING SCHOOLS IN OBTAINING EMPLOYMENT.

	Cornell University.			Mass. Inst. of Technology.			Lehigh University			Total Results.			
	Electrical.	Mechanical.	Civil.	Electrical.	Mechanical.	Civil.	Electrical.	Mechanical.	Civil.	Electrical.	Mechanical.	Civil.	Total.
No. of letters sent.	35	30	25	46	24	20	27	17	36	108	71	81	270
Per cent. of letters replied to	31.4	34 3	48	69.5	33⅓	50	33.3	47.0	47.2	48.1	39.4	48.1	44.1
Per cent. of those replying who had secured employment	63 6	66 6	91.7	78 1	62.5	90	100	100	82.2	78.8	75.9	71.8	
Per cent. of those replying who had secured employment in the line of work for which they studied	45.4	66.6	91.7	65.6	62 5	90	88.8	87.5	82.3	65.3	71.4	87.1	
Per cent. of those replying who had secured employment through influence of relatives	18.1	0	16.6	20	40	0	44.4	12.5	11.7	21.1	10.7	11.1	
Per cent. of those replying who had secured employment through influence of friends	0	33.3	25	24	40	77.7	22.2	37.5	23.5	15.3	32.1	35.8	
Average working day	8 h. 42 min.	8 h. 30 min.	8 h.15 min.	8 h. 48 min.	9 h. 22 min.	8 h. 34 min.	9 h. 12 min.	9 h. 15 min.	8 h. 34 min.	8 h. 54 min.	8 h. 56 min.	8 h 27 min.	
Average pay per week	$9.70	$15.31	$13.65	$11.31	$14.12	$13.81	$10.64	$10.75	$12 69	$10.70	$13.52	$13.27	
Average rate paid per hour on basis of 5½ working days per week	20.2 cts.	32.7 cts.	30.0 cts.	23.3 cts.	27.4 cts.	29.1 cts.	21.0 cts.	21.1 cts.	26.8 cts.	21.8 cts.	27.4 cts.	28.5 cts.	

The accompanying tables shows the tabulated and averaged results of the replies received. There is a table for the graduates from each college, and also a table of the total. In making up these tables, I have tried to be fair and strictly impartial—not a difficult task, as the replies were usually direct and to the point; only in one instance was there a refusal to inform me as to salary.

Considering only the table of total results, which may be taken as a fair indication of the condition of the recent graduates in electrical engineering, it will be found that, while a greater per cent. of the graduates in electrical engineering secure employment, as compared with the other graduates, yet the fewest, relatively, secure employment in the line of work for which they had studied—that is, in order to get employment, they had to take positions in which their electrical knowledge did not count. It will furthermore be noticed that almost twice as many men secure employment in electrical engineering through the influence of their relatives as in mechanical or civil engineering, while about half as many obtain positions through their friends as in the other two professions.

The working day averages about the same number of hours in each profession. Assuming 5½ working days per week, it will be seen that the electrical graduate receives over 20% less per hour than the mechanical graduate, and 23% less than the civil graduate, who is best paid of all.

We have studied the table presented by Mr. Floy, the author of the paper above referred to, with much interest, and doubt not that our readers will do the same. The comparison between the experience of graduates from different colleges, which is made in the first nine columns of the table, is hardly of sufficient importance to merit more than a passing comment, as the total number of replies received are too small to draw any conclusions of value as to the relative experience of graduates from either of these three great institutions. But the summary in the last three columns covers a sufficiently large number of cases to make it worth a careful analysis.

The first noteworthy fact is that Mr. Floy's replies, from which his table is made up, comprise only 44% of the graduates to whom he sent letters.

Now what are the probabilities respecting the other 56% who did not reply to Mr. Floy's query? Is it not exceedingly probable that very few of them had secured positions, and that this was, in nine cases out of ten, the reason why no answer was returned? The young man who has a place does not generally hesitate to tell of it. It is the one whose many attempts to secure something to do have ended in failure and who feels more or less of mortification over it who is in the mood to resent such a letter of inquiry as Mr. Floy's and omit to answer it. From the figures in the table it appears that of 110 graduates reporting, 90 had secured employment. Suppose that out of the 151 graduates who failed to answer the letter there were 20 who had secured employment, which seems to us a liberal estimate. Then we have a total of 110 out of 270 graduates, or about 40%, as the total securing positions within three months after leaving college.

The question which Mr. Floy's statistics fail to answer is, what becomes of the other 160 men; do they go back to work on the farm or in the store or shop or mill in places where their technical education is of no practical service to them?

If it is indeed true that 60% of our engineering graduates find no opportunity to put their technical attainments into practice, the matter would be a very serious one. Granting all the benefits of a broad engineering education in enlarging a man's mind and character and broadening his mental horizon, these benefits may be purchased at prices which few young men starting out in life can afford to pay, unless some financial gain is ultimately to result.

We do not believe, however, that so large a proportion of engineering graduates or anything like so large a proportion fail, permanently, to find positions in which their technical knowledge is brought into play. It must be remembered that the industries which employ engineers are carried on to make money, not to furnish employment. Vacancies occur or new men are required on account of expanding business at a fairly regular rate throughout the year. The influx of a thousand or more graduates, which are turned out in June of each year from the technical schools, cannot possibly be absorbed at once. That 40% of these men should have salaried positions within three months of graduation is a remarkably good showing, rather than a remarkably poor one. We doubt not that during the remaining nine months before the class of 1896 is in the market for positions, a goodly proportion of these 160 men which we have supposed still wanted positions in September last, will have found them.

Of course in every year's output of the schools, there are some men who, from personal deficiencies of one sort or other, or merely from preference, never take up any line of active industrial work. There will be more or less of these even in the best of times; for in every engineering school there are those who pursue the full course of study and take their diplomas, who have no natural fitness for engineering or for the industrial pursuits allied to it.

A feature of Mr. Floy's table of quite as much interest to the young engineer as the percentage of graduates securing employment, is the average salary received. From the student's point of view it is eminently discouraging that after completing an expensive education, ending with four years of hard study at the best engineering schools of the world, a man should have to take a place at $2 per day and count himself very fortunate to get that.

But there is another point of view. Is it not rather remarkable that with over a hundred engineering schools turning out men with excellent training every year, and when it has become so easy for a young man to secure such a training, the supply of such men should not be so far in excess of the demand as to force salaries down much farther than it actually the case?

Let us make some comparisons. A boy of 17 or 18 may get a position in an office or store at $5 to $8 per week, and four years later his pay may be $10 to $15. During that four years he will be learning some business routine and little else; and what is most important, he can look forward to no very considerable increase as the years go on. We are speaking, of course, of average results, in the case of youths who have only their own efforts to rely upon. If the same youth learns a trade, he will spend three years as an apprentice, and at the end of that time will be doing well if he earns as a skilled workman $15 a week the year round; with nothing higher to look forward to at best than a place as a foreman.

The same youth, if he have the requisite natural abilities, can spend four years at an engineering school, and at the end of that time can begin his life work at nearly as large wages as a brother who learned the machinists' trade, or another who entered a store will then be receiving: but with this large difference that the man with the engineering education has been so developed and broadened that he can look forward to filling positions of greater responsibility and greater compensation as the years go on. Four years of time and a pecuniary investment of $1,200 to $2,000 probably represent the cost of the average engineering education. We believe few graduates will deny that their investment of time and money has been on the whole a profitable one.

It will be seen from our quotation above from Mr. Floy's paper that he deduces from his statistics the conclusion that there is a greater overproduction of electrical engineers than of graduates from courses in civil and mechanical engineering. He says the civil engineering graduate is the best paid of all, averaging 23% higher pay than the electrical graduate. But he fails to point out the fact that the young civil engineer—or the older one, for that matter—has to accept positions which are seldom permanent, and which generally furnish employment for only a year or two at longest. In view of this fact, it can hardly be considered that the pay of the civil graduate is on the whole any higher than that of his electrical brother. In fact if full weight is given to the uncertain duration of civil engineering work and its intimate dependence on general industrial conditions, it would probably

be found that the electrician is considerably the better off of the two, so far as his first salary returns are concerned.

We are far from arguing from this, however, that the electrical graduate has, on the whole, the better ultimate chances of good success. On the contrary, Mr. Floy's statement that the popular craze on all matters electrical is resulting in turning far too many young men toward the study of electrical engineering is doubtless correct.

The most notable defect in American engineering schools to-day is probably the tendency to specialize, to make the students competent workmen in some particular lines rather than broadly capable in all lines. We are aware that the pressure is strong in this direction, and that the schools are being constantly urged by parents, pupils and employers to turn out skilled draftsmen, transitmen, computers, electricians. There is, indeed, much to be said in favor of a course of study which enables a student to do some one thing well enough to earn his living by it, as soon as he leaves his studies; but that is after all the least valuable of the benefits which a technical education confers. The student whose training is so broad that he can take up any department of engineering and gain by himself the special knowledge to make him proficient in it, is the man who gains most from his college course, and is most able to fill successfully those highest executive positions which are the best rewards to which members of the profession aspire.

LETTERS TO THE EDITOR.

Expanded Metal Filter Tanks at Pittsburg, Pa.

Sir: In my recent communication embodied in your article on sand filtration experiments in Pittsburg, I spoke of a slight "leakage" from the expanded metal and cement tank when it was first made. There was however no real leakage, but rather a temporary efflorescence caused by an uneven escape of water from the cement, especially in the neighborhood of the gage glass inlets. The tank subsequently assumed a uniform appearance and has been from the start very strong and in every way satisfactory.

Yours very truly, Jas. M. Handy.

Pittsburg, Pa., Dec. 28, 1895.

Steel Castings for Steam Pipes and Pipe Fittings.

Sir: Referring to the editorial in your issue of Dec. 19, on "Danger in Cast Iron Steam-pipe Elbows," in which you suggest that steel castings should be used instead of cast iron for such elbows, we desire to state that we have furnished to power plants and manufacturing concerns within the last year, over 300 tons of high pressure fittings and steam pipe, made of steel castings, which were made much lighter than cast iron, were easier to handle, and possess a greater factor of safety.

The shrinkage of steel castings is greater than iron and necessitates greater caution in manufacturing. The greatest lengths of steam pipe that have been cast by this company, with flanges cast on, were 12 ft. long. They were all made successfully, and tested under hydraulic pressure before leaving the works, to 1,500 lbs. per sq. in.

A great success has been achieved within the past few years in overcoming the difficulties encountered in the making of irregularly shaped castings, and the making of safe steam pipe and fittings out of steel castings is no longer an experiment.

Yours truly, Penn Steel Casting & Machine Co.,
136 Liberty St., New York.

Jan. 4, 1896.

Monumenting Government Surveys.

Sir: I notice in your issue of Dec. 12, that the question of suitable material to use for corners and bench marks in public surveys is being discussed.

There is much more in this matter than simply marking the points. In the work of the Mississippi River Commission it was found difficult to get a suitable mark that was free from objections. After a great deal of experience, it was decided that a satisfactory mark must consist of two parts viz: a sub-surface mark far enough down to be free from effects of frost and out of the reach of vandals; and a surface mark resting on and centered over the lower mark, to be used as a witness mark and answer the purpose of the ordinary mark as long as it is found undisturbed.

A cast iron pipe wil not be found satisfactory, as it becomes too brittle in cold weather and can be easily destroyed. A wrought iron pipe with a cast iron cap suitably marked, answers very well for a surface mark.

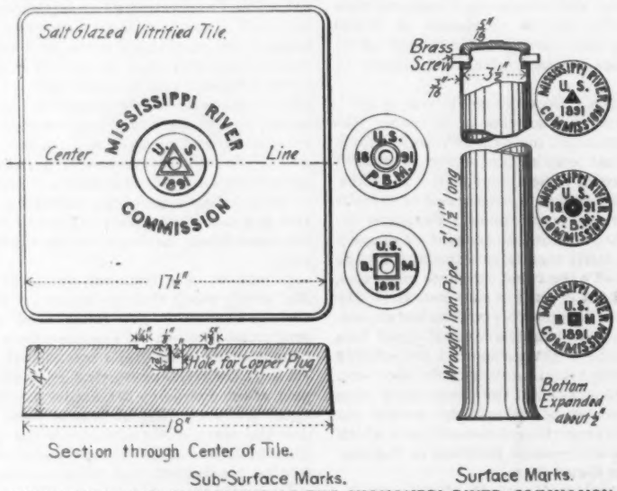
Undoubtedly the best thing for a sub-surface mark is a vitrified tile of proper dimensions. It is the most durable material known, and the facility with which it can be marked at small cost before burning adds much to its utility. If it is to be used as a bench mark it should have as broad a base as practicable, so that settlement will be reduced to a minimum. The surface mark should be expanded or flanged at the bottom so that it cannot be easily pulled out.

The utility of any mark depends much on its being lettered so plainly that when found it can be readily identified.

I enclose you a sketch of the marks which have been used in the work of the Mississippi River Commission for more than ten years and have given good satisfaction.

J. A. Ockerson.

St. Louis, Mo., Dec. 16, 1895.



MONUMENTS USED IN SURVEYS OF THE MISSISSIPPI RIVER COMMISSION.

Table of data from records of stone delivered by A.A. Hall & Co., at dam 2, additional supply, Boston watre-works, Framingham, Mass., from June 18 to July 20, 1877, inclusive:

Driver or Owner of Team.	Days work to haul Weight given in Col. 9.	No. of Horses.	Total No. of loads.	Average No. of loads per day.	Greatest No. of loads in any one day.	Weight of Horses, lbs.	Weight of Wagon and Driver.	Total net Weight in lbs., drawn in days given in Col.	Average net Weight in lbs., drawn per day.	Average gross Weight in lbs. drawn per horse per load.	Average net Weight in lbs., drawn per horse per load.	Average net Weight in lbs., drawn per load.	Average gross Weight drawn per lb. of horse flesh per load.	Average distance traveled per day, feet.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
McLaughlin	22	1	101	4.6	6	2,540	1,830	453,785	20,626	3,161	2,226	4,492	2.49	74,980
"	22	1	101	4.6	6									74,980
Bates	5	2	21	4.1	5	2,100	1,830	89,720	17,955	3,052	2,137	4,275	2.86	66,850
Craffey	12	2	67	5.7	6	2,365	2,800	198,885	16,573	2,884	1,484	2,968	2.46	92,910
Kelley	10	2	55	5.5	6	2,275	2,865	196,475	19,647	3,209	1,786	3,572	2.82	89,650
Kilburn	3	2	12	4.0	5	2,500	1,950	58,460	19,487	3,410	2,435	4,871	2.78	65,200
McDermott	7	2	29	4.7	5	2,600	1,570	139,000	19,857	3,183	2,398	4,797	2.45	76,610
Norton	4	2	19	4.3	5	2,370	1,670	83,090	20,772	3,061	2,186	4,373	2.69	70,090
Welch	23	3	108	4.7	5	3,565	1,785	542,335	23,536	2,269	1,974	5,922	1.91	76,610
Rollins	7	4	35	5.0	5	4,750	2,955	292,440	41,791	2,821	2,082	8,327	2.37	81,500
Bryant	7	4	33	4.7	5	5,125	3,115	304,450	43,497	3,085	2,306	9,223	2.41	76,610
Burke	7	4	33	4.7	5	4,750	3,000	245,670	35,095	2,611	1,861	7,445	2.19	76,610
Hennessey	8	4	37	4.5	5	4,070	2,335	177,730	22,216	1,785	1,201	4,803	1.75	73,350
Average						1,182	2,309			2,878	2,008		2.43	76,74[illegible]

The distance traveled by each team per round trip was about 6,372 ft., light or empty, and about 9,927 ft. loaded. The distance was obtained by pacing. The above weights were given by the weigher at my request.

Observed time to haul 6,372 ft. empty	35 min.	183 ft. per min.
Observed time to load	15 "	
Average time to haul 9,927 ft. loaded @ 5 trips per day	60 min.	165 ft. per min.
Average time unloading	10 "	
Average time per load	120 min.	

With the exception of two small rises the distance traveled loaded was all down hill and was a good road. The quarry was about 100 ft. above the dam site. The teamsters were paid 70 cts. per cu. yd., of 4.000 lbs.

The Engineering Work on the New Water-Works Intake at Erie, Pa.

Sir: Your issue of Dec. 5 contains a descriptive article on the extension of the water intake pipe of the Erie, Pa., water-works, written by Mr. W. C. Brough, of Toronto, the engineer of the work. Mr. Brough has probably forgotten, and therefore omitted to mention in his article, that less than a year ago the undersigned was requested by the Erie Commissioners to review Mr. Brough's plans. The examination had to be thorough, and covered the same ground as that covered by Mr. Brough before the project could be approved. Mr. Brough had made plans and specifications for the work, but no report thereon.

The general features of the plan were concurred in, but it was advised that several important details be changed to prevent an impairment of the success of the work. The writer's report containing these recommendations was embodied and printed in the last annual report of the Commissioners to the Mayor and Councils. Mr. Brough's article indicates that the advice just rendered, including the alteration of at least two important details, was adopted.

In view of the present agitation of the question of professional ethics in the Canadian Society of Civil Engineers, of which Mr. Brough is a member, he would no doubt have referred to the Consulting Engineer, as he did to the contractors, commissioners and to their secretary and treasurer, but for some lapse of memory.

Rudolph Hering.

New York, Dec. 8, 1895.

We have submitted Mr. Hering's letter to Mr. Brough and received the following reply from the latter:

Sir: I am surprised to see that Mr. Hering has taken umbrage at the omission of his name by me in the article published in your issue of Dec. 5. My article dealt principally with the material utilized and the manner of laying the intake as far as now let under contract, with which portion Mr. Hering has had practically nothing to do, except to approve of the original plans in the capacity of Consulting Engineer. I therefore did not think it necessary to make any more personal remarks, nor did I desire or imagine I was slighting or giving offence to anybody, and am therefore hurt at any reference being made to "Ethics," which reproof I am sure I do not deserve.

I remain, very truly yours, Walter C. Brough.

Toronto, Ont., Dec. 23, 1895.

A Table for Computing Flow in Sewers.

Sir: Your reference to certain features of our city reports for 1893 and '94, in your issue of Dec. 26, has flooded this office with applications for copies from every section of the United States and Canada, and conclusively proves the widespread list of your readers. The edition of our reports for 1893 is exhausted, and, as the demand for the copies of that report indicate largely the desire for a copy of the sewerage table, I send you a copy of that portion with the suggestion that you republish it for the benefit of the many who cannot procure a copy.

Very truly yours, Andrew Rosewater.
M. Am. Soc. C. E., Cy. Engr.

Omaha, Neb., Jan. 2, 1896.

Table of Velocity and Discharge of Circular Conduits Based on Kutter's Formula, n equals .013. Grade equals 1 in 100 (or s equals .01).

Diam. of Conduit. Ft.	In.	Veloc. in ft. per sec.	Disch. in cu. ft. per. sec.	Diam. of Conduit. Ft.	In.	Veloc. in ft. per sec.	Disch. in cu. ft. per sec.
	4	1.81	0.16	7	0	16.98	653.4
	6	2.52	0.49		3	17.37	717.2
	8	3.17	1.11		6	17.77	785.1
	9	3.47	1.53		9	18.12	854.7
	10	3.77	2.05	8	0	18.50	930.0
1	0	4.34	3.40		3	18.87	1008.9
	3	5.12	6.29		6	19.25	1092.4
	6	5.87	10.37		9	19.57	1177.1
	8	6.35	13.85	9	0	19.94	1268.6
	9	6.57	15.79		3	20.29	1363.7
	10	6.80	17.94		6	20.65	1463.7
2	0	7.24	22.74		9	20.99	1565.0
	2	7.67	28.27	10	0	21.31	1673.7
	4	8.08	34.53		3	21.65	1786.2
	6	8.48	41.64		6	21.99	1903.9
	8	8.88	49.59		9	22.28	2022.7
	10	9.26	58.63	11	0	22.62	2149.6
3	0	9.63	68.09		3	22.94	2280.5
	2	10.00	78.78		6	23.27	2417.0
	4	10.36	90.39		9	23.56	2554.3
	6	10.71	103.00	12	0	23.88	2700.5
	8	11.05	116.80		3	24.50	2850.8
	10	11.39	131.50		6	24.50	3007.0
4	0	11.73	147.40		9	24.77	3163.6
	2	12.07	164.50	13	0	25.09	3329.9
	4	12.39	182.70		3	24.19	2850.8
	6	12.71	202.20		6	25.69	3677.3
	8	13.01	222.40		9	25.95	3854.3
	10	13.31	244.20	14	0	26.25	4041.9
5	0	13.62	267.50		6	26.84	4432.2
	2	13.94	292.10	15	0	27.39	4839.9
	4	14.23	317.80		6	27.95	5274.5
	6	14.53	345.10	16	0	28.48	5726.8
	8	14.78	373.00		6	29.03	6208.4
	10	15.07	402.80	17	0	29.55	6707.1
6	0	15.36	434.30		6	30.08	7236.3
	3	15.78	484.20	18	0	30.58	7783.1
	6	16.20	537.70	19	0	31.59	8958.4
	9	16.57	593.10	20	0	32.58	10236.0

Table of Grades per 100 and their Square Roots.

Grade per 100	Square Root of Grade.	Grade per 100	Square Root of Grade.	Grade per 100	Square Root of Grade.
.04	.200	1.20	1.095	3.15	1.775
.05	.224	1.25	1.118	3.20	1.789
.06	.245	1.30	1.140	3.25	1.803
.07	2.65	1.35	1.162	3.30	1.817
.08	.283	1.40	1.183	3.35	1.830
.09	.300	1.45	1.204	3.40	1.844
.10	.316	1.50	1.224	3.50	1.871
.11	.332	1.55	1.245	3.60	1.897
.12	.346	1.60	1.265	3.70	1.924
.13	.361	1.65	1.285	3.80	1.949
.14	.374	1.70	1.304	3.90	1.975
.15	.387	1.75	1.323	4.00	2.000
.16	.400	1.80	1.342	4.20	2.049
.17	.412	1.85	1.360	4.40	2.098
.18	.424	1.90	1.378	4.60	2.145
.19	.436	1.95	1.396	4.80	2.191
.20	.447	2.00	1.414	5.00	2.236
.22	.469	2.05	1.432	5.20	2.280
.24	.490	2.10	1.449	5.40	2.324
.26	.510	2.15	1.466	5.60	2.366
.28	.529	2.20	1.483	5.80	2.408
.30	.548	2.25	1.500	6.00	2.449
.35	.592	2.30	1.517	6.50	2.550
.40	.632	2.35	1.533	7.00	2.646
.45	.671	2.40	1.549	7.50	2.739
.50	.707	2.45	1.565	8.00	2.828
.55	.742	2.50	1.581	8.50	2.915
.60	.775	2.55	1.597	9.00	3.000
.65	.806	2.60	1.612	9.50	3.082
.70	.837	2.65	1.628	10.00	3.162
.75	.866	2.70	1.643	11.00	3.317
.80	.894	2.75	1.658	12.00	3.464
.85	.922	2.80	1.673	13.00	3.606
.90	.949	2.85	1.688	14.00	3.742
.95	.975	2.90	1.703	15.00	3.873
1.00	1.000	2.95	1.718	16.00	4.000
1.05	1.025	3.00	1.732	17.00	4.123
1.10	1.049	3.05	1.746	18.00	4.243
1.15	1.072	3.10	1.761	20.00	4.472

METHOD OF USING THE TABLE.

To find the velocity and discharge of a 3 ft. 8 in. sewer on a 2.25% grade. Find the velocity and discharge as given in the table opposite 3 ft. 8 ins. and multiply them by the square rooot of 2.25.

Thus 11.05 multiplied by 1.5 equals 16.57, the required velocity.

Thus 116.8 multiplied by 1.5 equals 175.20, the required discharge.

When the velocity and discharge is desired for different values of n than (n equals .013) very good approximate values can be deduced as follows:

For n equals .011 multiply tabular quantities by 1.20
For n equals .012 multiply tabular quantities by 1.09
For n equals .015 multiply tabular quantities by 0.84
For n equals .017 multiply tabular quantities by 0.73

These can be used with a limit of error of 10% and it is only in the extreme cases where the error exceeds 5%.

The above approximations give excessive values for small diameters and insufficient values for large diameters.

The Cost of Hauling Freight on Common Roads.

Sir: In your estimate (Engineering News, Dec. 5), of the cost of hauling produce, etc., on common roads, I think you consider the wagon to be loaded both ways, which is seldom the case in this kind of hauling. While on construction of the Santa Fe R. R. in Oklahoma, I paid 1 ct. per 100 lbs. per mile (20 cts. per ton mile). This was the usual price for freighting provisions, as they could only load one way.

Yours very truly, Geo. M. Walker, Jr.

Argentine, Kan., Dec. 10, 1895.

Sir: I have been very much interested for the past 10 years in the good road problem, consequently I was very much interested in the articles in your issue of Dec. 5 and 19 on this subject. In your issue of Dec. 19 Mr. Wm. Haely has given an estimate of what it costs per ton to haul freight over good roads, which is certainly a very good showing, I think. In your comments you expressed a desire to know what was charged by 4 or 6-horse freighters of a half century ago. I cannot go back so far as 50 years, but I can give you what the freight charges were by four-horse freighters in southwest Virginia from about 1878 to 1883. For years previous to 1883 my father owned and operated four-horse freighters between Keysville, Va. (which was the nearest railway station), and Chase City, a distance of 20 miles. That is, it was 20 miles during the good road period (?) but in wet weather it was considered 40 miles, and rightly so, I think. His rate for hauling was 25 cts. per ton per mile in the summer and fall, but when the roads got wet and muddy in winter the rate was raised to 30 cts. per ton per mile, and I have known it to be as high as 45 cts. per ton per mile. My father often told me that at this rate he only made a fair return on the money invested. In dry weather a four-horse team could only draw about 4,000 lbs., and I have known the roads to become so horrible that a four-horse team could not drag more than 1,500 or 1,800 lbs. At the foregoing rates per ton per mile, the average corresponds very closely to the average given for the middle southern states by the agricultural department. Yours very truly,

J. C. Nelson,

Engr. Maintenance of Way, "Big Four Route."

Springfield, O., Dec. 27, 1895.

Sir: In your issue of Dec. 5 you have an article on the cost of hauling freight on common roads. So far as my experience goes, I am rather inclined to think your estimate of the cost per ton per mile rather low. I enclose you a copy from my note books of information gathered by me while assistant on the Boston waterworks in 1877, which in this connection may be of interest. The roads were good, and were probably better than the average country road. The two first lines in the table were loads drawn by one-horse carts. You will notice that the one and two-horse teams gave the best average weight per load, both gross and net weights. My recollection is that the price paid was hardly considered a fair compensation, the owners finally giving up the work on this account. The approximate compensation was about 12 cts. per ton per mile. Yours truly,

James H. Harlow.

210 Times Bldg., Pittsburg, Pa., Dec. 23, 1895.

ROUND-HOUSE FLOORS.*

We find that most of the members of this club are using the wooden floor, but would prefer some good composite floor. It would, however, be a very difficult matter to say what would be the best flour; one that would combine durability and cheapness, from the fact that a round-house floor is subjected to various changes, and very hard usages, and should be able to withstand the heavy pressures from jacks, etc., the rolling of trucks and other heavy parts of machinery over it, the action of the hot water from the cylinder cocks and overflow pipes, and the oil drippings from the truck boxes. All these have more or less effect on floors.

Your committee believes that a floor made of vitrified brick, in the following manner, will be found very serviceable: Make a bed of furnace slag or chert, about 18 ins. thick, then put a coat of sand over the slag, lay the brick on their edges, and level them up by tamping. After this is done, a coat of hot tar is applied, which enters the spaces between the bricks and cements them together. The bricks should be laid in such a way that good drainage may be obtained, and the floor washed off occasionally with the hose.

As the floor close around the pits is subjected to harder usage and more severe strains than any other part, we would suggest that a piece of timber, about 12 × 14 ins. be laid the full length of the pit, by the side of the one that supports the rail. This timber should be supported by brick pillars, built up from the side of the pit walls about 6 or 7 ft. apart. This would make a good jacking block, which could be replaced without much trouble or expense, and would not need replacing often, as the oil drippings from the truck boxes would preserve the wood to a certain degree.

The Southern Ry. has a floor made of vitrified brick in its round-house at Knoxville, and it is reported as giving good satisfaction. Such a floor costs about $1 per sq. yd.

A good many of our members are using yellow pine floors, the sleepers buried in cinders, and the floor boards nailed securely to them. Old car sills can be used for the sills, and make the floor very cheap. Such a floor can be laid for about 36 cts. per sq. yd. Cement floors for round-houses are a failure, as they soon crack and flake off after being used a short while, under the varying changes they are necessarily subjected to.

We are informed that the Ashland Coal & Iron Co. has a floor in its machine shop, at Ashland, Ky., which has been in use for nine years, without any apparent wear or cracks from any injury received during the year of service. This floor was made by filling in with slag from iron furnaces, for a depth of 18 ins. to 2 ft., well broken up and packed or pounded down; then sand was put over this so that it would pack down between the lumps of broken slag. The whole was covered with a cement made from the same kind of slag, crushed and pulverized in an ore pan, and mixed with water until it reached the consistency of mortar. This was put on to a thickness of 3 or 4 ins., and rolled well with a heavy iron roller. Mr. E. M. Roberts, formerly Master Mechanic of that road, informs us that this material makes a very hard and durable floor, as the material seems to run together and form one solid mass, which has the appearance of rock; but it is a question in our minds as to the durability of this kind of a floor for a round-house, inasmuch as it would be subjected to the changes of expansion and contraction.

* Abstract of a committee report presented at the November meeting of the Southern & Southwestern Railway Club.

THE NEW YORK STATE CANALS.

In his annual report for 1895, Superintendent of Public Works George W. Aldridge includes a review of the canal trade and tonnage for the year, and also touches upon the present condition and proposed improvement of the canals. The total expenditure out of the ordinary repair fund was $754,362; the expenditure for improvements out of special appropriations was $551,120.

The silting up of the canals, says Mr. Aldridge, has been going on for 25 years, and in default of appropriations for this purpose the only cleaning done in this time has been the removal of bars formed by inflowing streams. The result has been the gradual accumulation of deposits in the canal prism aggregating not less than 2,250,000 cu. yds. in the Erie Canal alone, and a proportional amount in the other canals. If this amount of silt were uniformly distributed over the bed of the canal the draft of boats would be reduced from 6 ft. to 5 ft. 4 in. But by adopting new methods of propulsion and by hard work the boatmen have succeeded in keeping open a narrow channel deep enough for their boats.

Mr. Aldridge advocates such improvement as will enable a large increase in the speed of boats; and he regards this feature as being much more likely to benefit boatmen than any attempt to simply increase the carrying capacity of individual boats. The cost of any increase in the present width of the canals would be out of proportion to the benefits obtained.

Regarding railway competition, the Superintendent says that the sudden reduction by the railways of 50% in the 1895 rates for wheat carried from Buffalo to New York does not seem to have been justified by any special increase in the carrying capacity of the railways, or by any material or abnormal increase in equipment. He rather suspects that this remarkable and sudden drop in rates was intimately connected with the fact that the question of appropriating $9,000,000 for the improvement of the state canals was to be submitted to popular vote. If the usefulness of canals could have been discredited before the people, by an overwhelming reduction in trade and tonnage, there might have been resultant benefits to the railways.

In 1895 the state canals carried 3,500,314 tons; of which 2,327,481 tons were moved towards tidewater and 1,172,835 tons went westward. Of these amounts 1,762,663 tons were through freight

and the balance way freight. The amounts carried by the several canals were as follows:

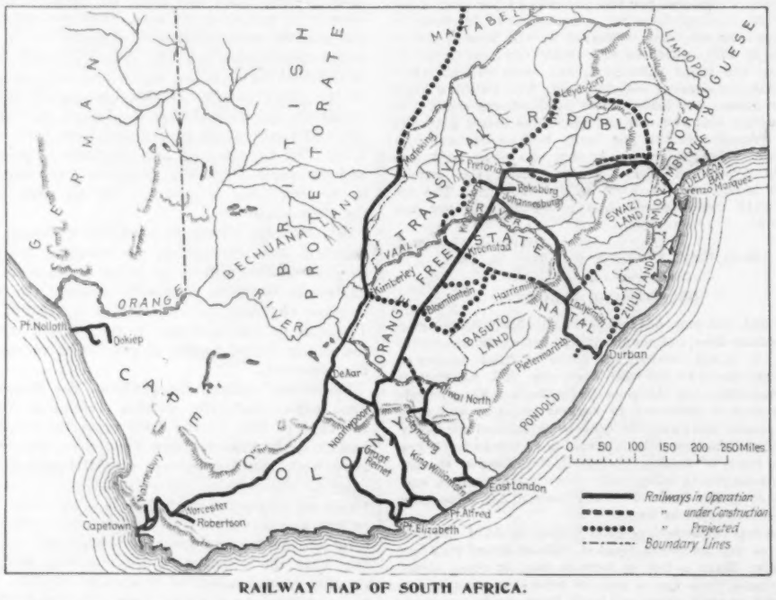
Erie Canal,	2,356,084	tons
Champlain Canal,	966,335	"
Oswego Canal,	64,691	"
Black River Canal,	64,154	"
Cayuga and Seneca Canal	49,050	"
Total,	3,500,314	tons

Mr. Aldridge regards the $9,000,000 improvement appropriation as in no sense a canal enlargement fund; but says that that amount is needed to put the canals in as perfect a condition as possible, with all present dimensions retained except as to increased depth of water. As soon as plans are prepared he will let contracts for extensive excavation in rock at Buffalo, through the ridge at Lockport, at Oswego and elsewhere. He hopes much of this work may be done this winter. He asks for the appointment of a deputy superintendent of public works.

THE RAILWAY SYSTEM OF SOUTH AFRICA.

Within the past few years a very great development has been made in the railway system of the southeast section of Africa, owing to the rapid growth of the newer colonies, and we present herewith a map showing the present condition of the railway system of this district.

One of the most important of the new lines is the Netherlands South African Railway, extending across the Transvaal (or the South African Republic) from the eastern frontier to Pretoria, and thence down to Johannesburg and the southern frontier. At its southern end, on the Vaal River, it connects with a line crossing the Orange Free State, which in turn connects with a line of the Cape Government Railways from Nauwpoort to Port Elizabeth (and also to Cape Town). At its eastern end, at Koomati Poort, it connects with the Delagoa Bay & East African Railway, 3 ft. 6 ins. gage, 51 miles long, which extends across Portugese territory to the port of Lourenco Marques, on Delagoa Bay. From Johannesburg there is also a line extending to a connection with the Natal Government Railways at Charlestown, giving through communication to the port of Durban. The Netherlands South African Railway was built by an American syndicate for a Dutch company holding a concession from the Transvaal government. It is of 3 ft. 6 ins. gage, with 425 miles open and 185 miles under construction, and its equipment includes 92 engines, 178 passenger cars and 1,500 freight cars.

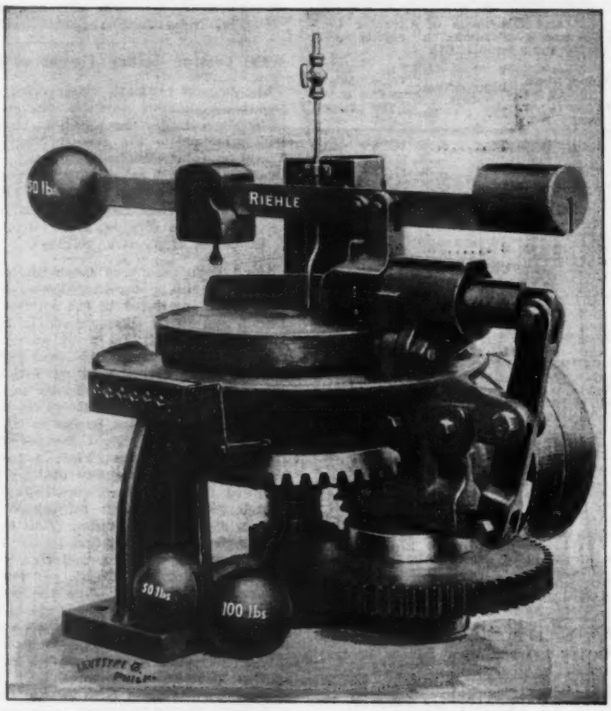


RAILWAY MAP OF SOUTH AFRICA.

(There is now connection between East London and the line crossing the Orange Free State, the railway shown by a dotted line being completed.)

The Transvaal has therefore outlets to all the important ports, including Cape Town, Port Elizabeth (724 miles), Port Alfred, East London, Durban (440 miles), and Lourenco Marques (348 miles). From Koomati Poort a French company is building the Northern Railway of the South African Republic to Leydsdorp, opening up a mining region, and has about 200 miles of 3 ft. 6 ins. gage now under construction.

The Cape Government Railways, of Cape Colony, comprise three main lines, extending from the ports of Capetown, Port Elizabeth, and East London. The total length of the system is 2,270 miles, all of 3 ft. 6 ins. gage, including the line extending across the Orange Free State. The equipment comprises about 377 locomotives, 439 cars in passenger service and 6,072 cars in freight service. Some articles on these lines will be found in our issues of April 27, June 1 and July 6, 1893 and July 5, 1894. The small line on the West Coast, extending from Port Nolloth to Ookiep, 100 miles, is that of the Cape Copper Co., and is 2 ft. 6 ins. gage. There is also an additional line (unfortunately shown as uncompleted by a dotted line on the map) connecting the line from East London with the main line crossing the Orange Free State. The railway authorities are now asking for bids for the construction of three light railways, as follows: 1, from Mossel Bay (halfway between Cape Town and Port Elizabeth, on the coast), eastward to Georgetown, Oudtshoorn, Willowmore and Kliplaat, 229 miles, connecting at the latter place with the Graaf Reinet Railway from Port Elizabeth; 2, from Somerset East (on the main line from Port Elizabeth to the Transvaal) eastward to Cookhouse, Bedford and Fort Beaufort, 76 miles; 3, a continuation of the latter line from Fort Beaufort to King William's Town, where it connects with a branch of the East London line.



A NEW MACHINE FOR TESTING RESISTANCE TO ABRASION.
Designed and Built by the Riehle Bros. Testing Machine Co., Philadelphia, Pa.

The Natal Government Railways aggregate about 339 miles, all of 3 ft. 6 ins. gage, and the equipment comprises 91 engines, 231 passenger cars and 1,450 freight cars. One of the enormous tank engines, with eight 38-in. driving wheels and six truck wheels, used on the heavy grade divisions, was illustrated in our issue of Feby. 8, 1890. These engines have a total weight of 100,800 lbs. with 69,300 lbs. on the driving wheels.

Besides the lines in the territory shown on the map there are four important pioneer railways, two on the West Coast and two on the East Coast. On the West Coast are the the Royal Transafrican Ry., now nearly completed, from St. Paul de Loanda to Ambaca (in the province of Angola), with 220 miles of meter gage; and the Congo Railway, which is under construction by a Belgian company, from Matadi to Stanley Pool, a distance of 270 miles. This line is of 2 ft. 3½ ins. gage, and has been completed for about 30 miles. On the East Coast the Beira Railway, 2 ft. gage, extends 180 miles from Beira, on the Pungwe River, to Chimoyo, and is being extended to the Mashonaland goldfields. Work is also about to be commenced by the British Government on a line of 30-in. gage from Mombasa to Uganda, at which latter point it will connect with navigation on the Victoria Nyanza.

Richmond, Ind., is rejoicing over the increased pressure of its natural gas supply, which has been caused by the gas pumps installed near the wells at Chesterfield, Md.

A MACHINE FOR TESTING RESISTANCE TO ABRASION.

Many engineers have felt the need of a machine which would test the hardness of various substances or their capacity to resist abrasion. We illustrate herewith a machine for this purpose which has recently been designed by the Riehle Testing Machine Co., of Philadelphia, and one of which has been built for the Cambria Iron Co.

As seen by the illustration, the machine consists of a grinding disk turning on a vertical spindle which is driven by bevel gears and 10-in. pulleys. A block of the material to be tested is pressed against this disk and is made to slide backward and forward, at the same time that the disk revolves, by the spur gearing and cam seen in the cut.

The grinding disk is of hardened steel, and when the test is in progress it is fed with sand or other abrading material and water; the surplus runs off by a spout at one side. The arm carrying the cube to be tested can be loaded to bring any pressure desired upon the specimen up to 200 lbs.

In operating the machine, the pulleys are given a speed of about 150 revolutions per minute, driving the disk at one-third that speed, and a revolution counter records the number of turns during the test. The machine will test cubes of 1 in. or smaller or can be arranged for 2-in. cubes. It is so designed that the wear will be uniform over the surface of the grinding disk, and that other parts of the machine will not suffer from the abrasives used.

Tests of steel rails, armor plate, asphalt, paving brick, journal bearings and a great variety of other materials may be made on this machine, and should result in a great increase in the knowledge of these materials.

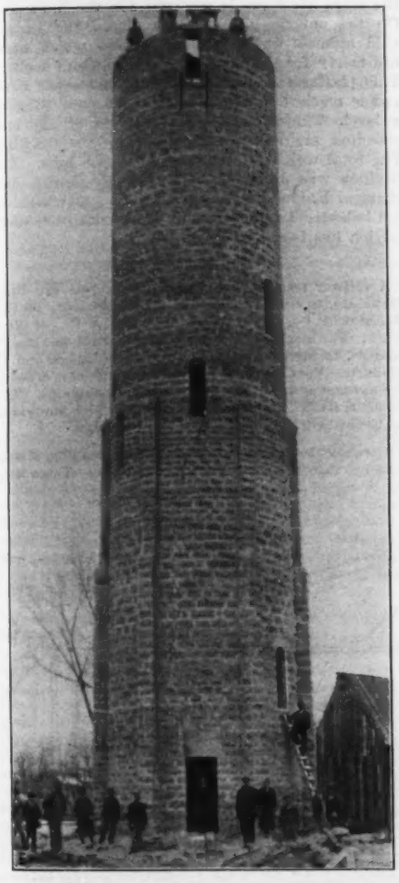
FAILURE OF A MASONRY WATER TOWER, LENA, ILL.

We illustrate in the accompanying cuts, a masonry water tower, which failed under somewhat peculiar conditions on the morning of Dec. 25, 1895. This tower was built for the village of Lena, Ill., by the U. S. Wind Engine & Pump Co., of Batavia, Ill., and through the courtesy of that firm we have been furnished with the photograph from which the engraving of the wrecked tower is made, and also the following description of the accident:

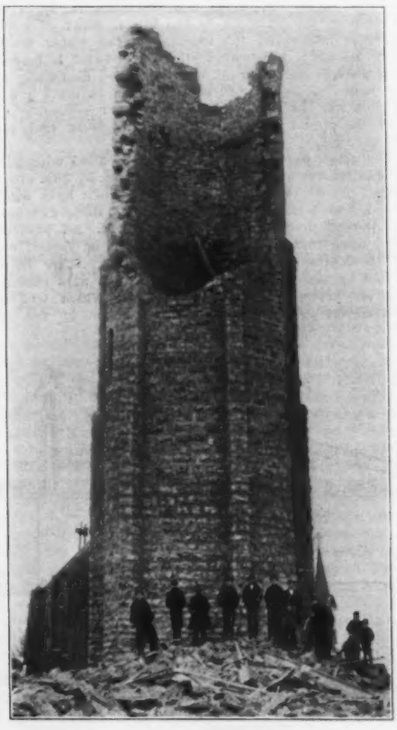
SIR: We contracted with the village of Lena, Ill., to put in a water-works system for them last fall, and among other things there was to be a water tower to support a 2,000-bbl. tank, the same to be elevated 90 ft. above the ground. After we had placed the order for the steel, however, the Village Board learned that it would take some five months to obtain the material, and not wishing to stand this delay they asked us to consent to substitute a stone water tower, which we did. We sublet the mason work to a firm of contractors which has built a great many similar structures for us.

It was getting late in the season and the rock was unquarried. Our winter in Northern Illinois came on about a month sooner than usual. The water tower had progressed to a point just above the pilasters, or in fact, just two courses above, when our cold wave of about De . 1 came on. The work was carried on notwithstanding the cold weather. Up to Dec. 1 half lime, half Milwaukee natural cement mortar had been used, but after the freezing weather occurred, nothing but cement was used for mortar. The I-beams and tank joists had been placed and a temporary covering placed on the top, and then further work was discontinued until spring.

The tower stood for about 10 days before any thaw occurred. There was some 15 ins. of snow on the ground when warm weather and rain ensued lasting about a week. By record more than 6 ins. of water fell in one 24 hour period, and some 15 ins. altogether. This rain came with a driving wind from the south during all of this period.



View of Tower After Completion.



View After Failure.

MASONRY WATER TOWER AT LENA, ILL.; FAILED DEC. 25, 1895.

In our opinion the accident was due to a peculiar combination of circumstances. In the first place the rock was not properly seasoned; in the second place, the thaw was of an unexpected duration; and in the third place, the unusual amount of rain, with the driving wind, together with the action of the frost which released the mortar from the stone, simply flushed the green cement from a portion of the tower on the south side. The stones are of a peculiar limestone, being very roughly bedded by nature and full of drifts. The immediate cause of the accident was probably owing to the splitting of one of these stones which had lost its bed of mortar, and thus precipitating a land slide, or perhaps better, a rock slide.

The writer, in talking with an eye witness, learned that the first break occurred at a point about 30 ft. below the top, directly to the south. This was followed almost immediately by all of the rock which fell. The accident took place on Christmas morning. A hasty examination showed that the foundations were perfectly true and level, and that all of the stone up to the point two courses above the pilasters were sound and good. All above this point we have decided to remove, though it is questionable whether it will not freeze dry and confirm our theory that the frost in the stone and mortar was not alone the cause of this accident.

We are making tests of the stone used in the construction of this tower, also the cement used. We have not put the cement under a machine test as yet, but a week's test shows that the cement is undoubtedly in good condition. We have samples set in water, samples set and frozen immediately after, and samples set dry, all showing very favorably.

We also send you a photograph of the Warren, Ill., tower, which is 102 ft. high. It is also designed to support a 2,000-bbl. tank. This tower is built of the same kind of stone, and was built 30 days sooner; it went through the same trying week of weather. It stands uninjured and is interesting when taken into consideration with the work at Lena, some seven miles away. We are going to resume work at Lena just as soon as the weather will permit. We thank you for coming to headquarters for information, and we have endeavored to tell you all that we know about this work, in every shape and manner.

Yours truly, U. S. Wind Engine & Pump Co.,
T. W. Snow, Asst. Genl. Agt.

Batavia, Ill., Jan. 8, '96.

In a personal interview a few additional facts of interest were secured from Mr. Snow. The height to the top of the pilasters is 50 ft., so that the masonry work extended about 40 ft. above that point. The top 20 ft. of this masonry was entirely destroyed, and for 20 or 25 ft. further down one side only crumbled and fell. The beams and joists for supporting the tank and stairway were torn out of the masonry and probably pulled it down more than it would have fallen if they had not been in place. The stone was from a local quarry, and stone from the same quarry can be seen in foundations and walls in the vicinity, where it has stood perfectly sound for years. The fallen stone shows no disintegration.

In addition to the above, we have received from a local correspondent a description of the construction of the tower and its failure, which closely corresponds to that given by Mr. Snow. We quote some extracts from this account as follows:

The tower was built with mortar of about one part of Milwaukee cement, one part good lime and six parts of sand (somewhat argillaceous). The masonry would probably be classed as "rough rubble"; the stones were roughly dressed to bed and were fairly well coursed. The soil on which the tower rested was clay and gravel, fairly dry, on high ground. The first 60 ft. was built in good weather and is still standing in very good condition. The last 30 ft. was constructed in cold, snowy weather. The stone was quarried and immediately placed in the wall. Apparently, instead of setting, the mortar froze solid. From Dec. 22 to 24 there occurred a warm rainstorm from the southwest; this beat into the joints and melted the mortar. For two or three days it was squeezed out of the joints and was constantly dripping to the ground to such an extent in fact that citizens predicted the catastrophe. On the evening of Dec. 24 a few stones dropped out at a height of about 60 ft. and very soon a chunk of wall about 10 ft. in diameter fell to the earth.

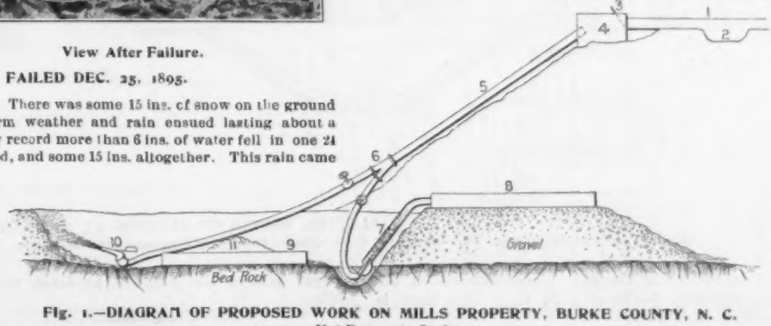


Fig. 1.—DIAGRAM OF PROPOSED WORK ON MILLS PROPERTY, BURKE COUNTY, N. C.
Not Drawn to Scale.

1, ditch; 2, sand-pit with drain; 3, screen at head of penstock; 4, penstock; 5, pipe (10 and 8-in.); 6, Y branching into 2 7-in. pipes; 8, top sluice-boxes; 9, pit sluice-boxes; 10, giant; 11, bowider and pebble heaps.

On Christmas morning the remaining upper southwest part of the tower fell and carried with it 10 ft. of the opposite side. The tower now stands 60 ft. high on one side and 80 on the other. The failure is attributed to two chief causes, first, the use of very green stone, and second very sudden change of weather conditions. The foundations probably had nothing to do with the accident, for that portion which remains is plumb and in fairly good condition.

A HYDRAULIC GRAVEL ELEVATOR IN A NORTH CAROLINA GOLD MINE.

In an exhaustive paper on "The Present Condition of Gold Mining in the Southern Appalachian States," by Messrs. H. B. C. Nitze and H. A. J. Wilkens, presented at the Atlanta meeting of the American Institute of Mining Engineers, the authors describe a novel method which is about to be used in reworking the old placer-deposits on the Mills property, Burke Co., N. C. The work is described as follows:

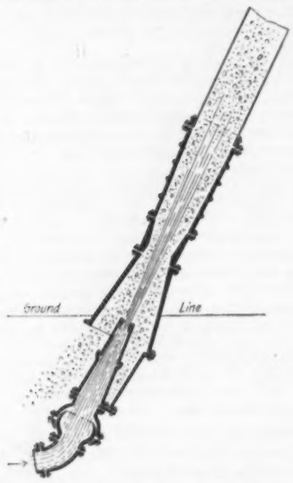


Fig. 2. Hydraulic Gravel Elevator, Mills Property, N. C.

The deposits are situated near the head-waters of Silver Creek. They are about a mile in length and are located mainly upon the west bank, on which the gravel often extends out a distance of 500 to 600 yds. The main difficulty encountered is the want of fall in the bed, a feature common to many Southern placers. It amounts in this case to less than 1 ft. in 100. To overcome this obstacle for hydraulicking with continuous sluice, the use of the hydraulic gravel-elevator was decided upon, and some experiments were made with it a few years ago. In the main, they were satisfactory, but were soon abandoned, the plant being unfit for continuous use, and monazite not being at that time a valuable product. Fig. 1 gives a rough sketch of the plant and method to be carried out by the present company. Twelve miles of ditch and flume line (1) carry the water from a reservoir, through the Dan Sisk gap in the South mountains, to a pen-stock (4), situated 200 ft. above the level of the creek bed. The ditch is cut about 8 ins. deep by 20 ins. wide, at a cost of about 25 cts. per rod, and is given a grade of from 1½ to 3 ins. in 100 ft. The flumes are, at ordinary grade, 18 ins. wide by 12 ins. deep.

The water, before reaching the pen-stock, flows through a sand-pit (2, Fig. 1), to catch sand, etc., washed into the ditch line from the side. It then enters the penstock after passing through a screen (3) for removing leaves, sticks,. etc. The pipe (5) running from the penstock is 10-in. spiral riveted sheet-steel (No. 16 Birmingham gage), coated with coal tar and connected with flanges. Smaller curves are made by placing cast-iron beveled wings between the gaskets of the flanges, larger ones by suitable elbows. Near the gravel-pit the 10-in. pipe branches out through a Y (6) into two 7-in. pipes, supplied each with a gate-valve, one leading to the giant (10) and the other to the hydraulic elevator (7). These are both of California type and manufacture.* An illustration of the latter in detail is given in Fig. 2. The principle of this device is too well-known to require a description. It is intended to keep the elevator stationary as long as possible, as its installation consumes considerable time. A pit must be sunk in the bed-rock, and as the elevator must also drain the workings (a drain on the top of the bed-rock to the initial point of working was considered too expensive), the water would gain too much headway while the elevator is moved. The work in the main pit will be carried diagonally up the banks of the stream, so as to gain as much grade as possible. As soon as there is room, a sluice-box (9) will be placed between the working-bank and the elevator pit.

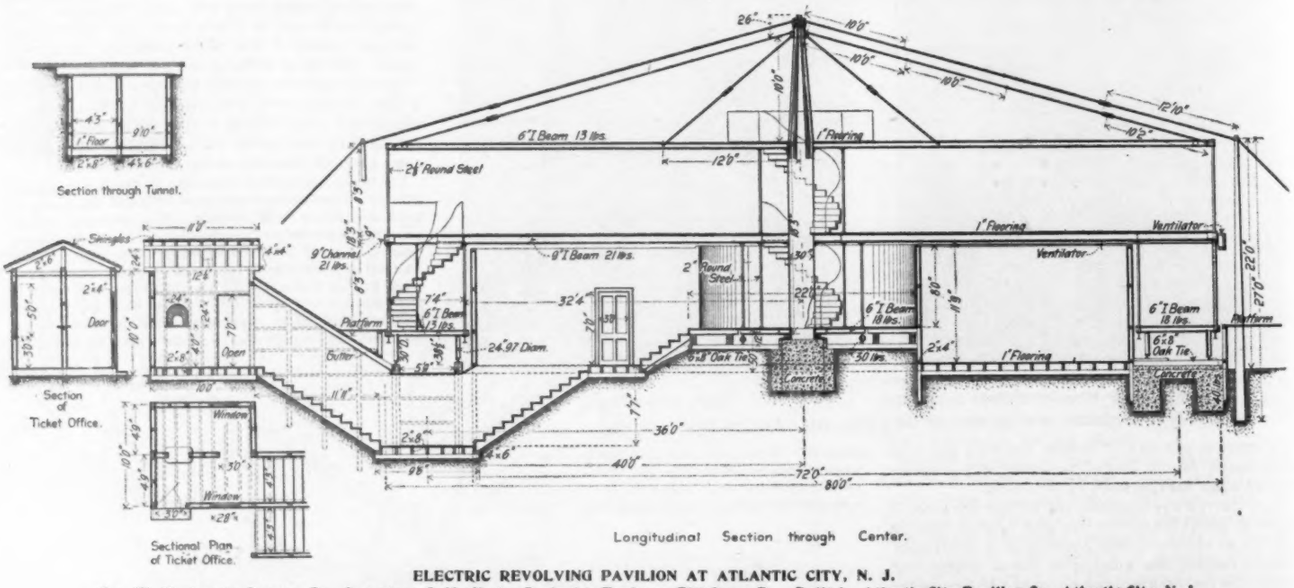
The upper part of this sluice will be filled with 3-in. by 4-in. blocks and the remainder by 1-in. by 3-in. cross-riffles, placed 11 ins. apart and held down by a sand-board, which is halved down on them. Both will help to protect the sluice-box against wear. All pebbles, etc., more than ½-in. in diameter will be forked out of the sluice and left in the pit (11). After being raised by the elevator, the material will pass through another sluice (8), the tailings from which will be worked for monazite. It is expected that by far the largest part of the gold will be saved in the first sluice.

*Joshua Hendy Machine Works, San Francisco, Cal.

REVOLVING PAVILION AT ATLANTIC CITY, N, J.

The somewhat widespread attention attracted by the "electric pavilion," or "flying pavilion," as it is variously called, which was built last season at Atlantic City, N. J., makes the illustration of that structure, presented herewith, of more than usual interest. Briefly described, this pavilion is an ingeniously constructed "merry-go-round," operated by electric power. As will be seen from the drawing, the structure consists of three platforms, one above the other, mounted on a ball bearing at the center, and having a row of castor wheels and two rows of larger track wheels for the outside supports. There are 32 track wheels, 25 ins. and 30 ins. in diameter, mounted on 16 axles. Four pairs of these wheels are positively driven by four 15-HP. street car motors. These motors get their current by means of trolleys, and current is also taken through a separate trolley for 450 incandescent electric lights, by which the pavilion is lighted.

Entrance to the inside platform is obtained by means of a subway and a flight of steps leading onto the slow-moving lower platform while the pavilion is in motion. From this slow-moving lower platform, a spiral stairway leads to the two platforms above. The second platform, which has an area of 5,032 sq. ft., forms the main floor of the pavilion, while the third platform is reserved for the musicians. On the outside platform are placed the various wild animals and beasts of burden which make life merry for the more youthful pleasure seekers. This platform has a speed of 10 miles per hour, and is reached from the outside, the floor being on a level. The various other features of the construction are sufficiently shown by the drawing. The total weight of the structure is 58 tons. The pavilion was designed by Mr. C. M. Clarke, Mechanical Engineer, of Pittsburg, Pa., to whom we are indebted for the drawing from which our illustration has been prepared.



ELECTRIC REVOLVING PAVILION AT ATLANTIC CITY, N. J.

Geo. W. Mackenzie, Beaver, Pa., Inventor; C. M. Clarke, Designing Engineer, Pittsburg, Pa. Built by Atlantic City Pavilion Co., Atlantic City, N. J.

A railway from Kingston, Jamaica, across the Blue Mountains to Port Antonio, has been completed for the Jamaica Ry. Co. by James P. McDonald & Co., of New York. The line is 50 mi es long, double track, and has 27 tunnels, 193 plate girder bridges, 11 truss bridges and 13 viaducts. Very heavy work was encountered in crossing the swamps and getting through the mountains. The Jamaica Ry.Co. is an American concern which purchased all the railways on the island a few years ago.

The abolition of grade crossings at Northampton, Mass., will include other expensive improvements. There will be an elevated structure through the city, a union station, and a reconstruction of the present freight yards. The cost will be divided between the city, the state, the Boston & Maine R. R. and the New York, New Haven & Hartford R. R.

An injunction restraining the newly organized Joint Traffic Association from operating under its agreement has been applied for in the U. S. Circuit Court by direction of the Attorney General.

Petroleum is being used for fuel in one of the locomotives of Southern Pacific Ry. The results are said to be so favorable that there is probability of its general adoption in the Southern California division of the system.

Tests of 27 different petroleum engines, made by the German Agricultural Society, are reported in the "Arbeiten der Deutschen Landwirthschafts Gesellschaft." The engines ranged in size from 2 to 12 HP., and the oil used was American petroleum of 0.80 and Russian of 0.82 density. Out of 25 engines, 15 showed an oil consumption ranging from 0.83 to 1.16 lbs. per brake HP. per hour; nine from 1.23 to 1.47 lbs., and one, an English engine, 2.61 lbs. After the brake trials seven of the engines were selected for a 60 hours' continuous trial, doing actual work in driving threshing machines. Although all the engines ran through this test, none was considered worthy of the first prize. Insufficient cooling of the cylinders, extinguishing of the lamp, excessive vibration and difficulty of varying the power were some of the defects developed in this continuous run.

An inspection tour of European ship canals is to be made by Major William Ludlow, Corps of Engineers, U. S. A., and late chairman of the Nicaragua Canal Commission. Major Ludlow is still military attache at London and has returned to his post. He is to visit the canals at Suez, Corinth, Kiel, Amsterdam, etc., and to examine into and report upon the natural difficulties overcome and the status of these canals as paying enterprises.

The Cleveland Steel Canal Boat Co. has contracted with the Nixon shipyard, of Elizabeth, N. J., to build 3 steamers and 10 barges for lake and canal freight service. Each vessel will be 100 ft. long, 18 ft. beam, and 12 ft. deep; the barges are to carry 270 tons of freight each, and the steamers 170 tons each. The boats will be built of steel, strong enough to warrant insurance against damage by lake storms, and they are expected to be ready for service by May 1 next

A forestry bill is to be introduced in the New Jersey legislature, appropriating money for a state warden who will divide the state into districts and have these district regularly patrolled, and will also have power to hire men to fight forest fires as soon as discovered. This action is the result of the serious forest fires in the southern part of the state last year, when nearly 150,000 acres were burned over in Cape May, Atlantic and Cumberland counties.

The reports of the Palisades Commissioners of New York and New Jersey have been sent on to the respective governors and they are practically identical. Both recommend the purchase of the cliffs and a strip of land by the U. S. Government as a site for military purposes, being the most available near New York. They ask that Congress legislate to this effect and appropriate $500,000, or as much thereof as is needed, to carry out the recommendations. Bills are being prepared for presentation to the State Legislatures giving the consent of the people to the acquisition of the land by the National Government.

A road improvement bill introduced in the House of Representatives provides that one senator, two representatives, the Chief of Engineers of the Army, the director of the Geological Survey and the Chief of Road Inquiry of the Department of Agriculture shall constitute a commission (continuing during the life of the present Congress) to investigate and report upon the best means by which the Government may promote the improvement of highways by the scientific location of roads on the public domain, the employment of the Geological Survey in the discovery of road materials, the free testing of road materials, the constructing of model roads, and instruction in roadmaking at agricultural colleges and experiment stations, the Military Academy, and, when practicable, at all institutions having a military instructor. The commission is also to confer with the Interstate Commerce Commission and with railway officials to secure reduced rates for the transportation of road materials, and by conference with State authorities and organizations to aid in awakening the general interest in road improvement. The bill only asks for the appropriation of the $10,100 returned to the Treasury unexpended from the last two years' appropriations for road inquiry.

The report of the special committee on good roads presented to the New York State Legislature on Jan. 13, states that there is great dissatisfaction with the present inefficient system of road management, and makes the following recommendations:

1. There should be at Albany a central head, to act in an advisory capacity and to have the superintendence of all roads hereafter built, the prime idea being that the maximum of utility shall be reached with the minimum cost.
2. State aid to the amount of one-third should be given, subject to certain conditions and restrictions, and the initiative may be taken by three alternative methods: (a) upon the petition of a benefited district paying one-third, the county one-third and the state one-third; (b) upon a petition of the town or by a resolution duly passed at any annual or special town meeting, in which event the town, county and state shall each pay one-third; and (c) upon a resolution of the Board of Supervisors petitioning for a county road, of which the county is to pay two-thirds and the state one-third.
3. The number of road officers should be decreased, and there should be one Commissioner of Highways in each town, acting in connection with the Town Board.
4. The present "pathmaster" system should be abolished, and the money system of taxation for highway purposes be used throughout the state.
5. A wide-tire law should be passed, to take effect in 1900 and regulating the width of tire to the weight carried.
6. The convicts in the state prisons should be utilized for the purpose of manufacturing the material for roadbeds at the prisons.

A Carnegie armor plate, representing 415 tons of 8-in. turret and barbette armor for the "Iowa" and the "Brooklyn," failed under test at Indian Head on Jan. 8. Two holes were cut in the plate so as to make it represent a port-plate on these vessels. One 6-in. Wheeler armor piercing projectile, weighing 100 lbs., and having a a velocity of 1,700 ft. per second, broke the target into three pieces, instead of merely cracking it as expected. A second test of the same plate was also unsatisfactory.

Smoke is to be abolished from Milwaukee chimneys in two years, according to an ordinance now pending in its City Council, which gives manufacturers that length of time to apply smoke-preventing appliances to their boilers.

A short-circuiting of wires leading from a monster 1,500-KW. dynamo in a St. Louis street railway powerhouse, caused a burn-out and a damage estimated at $10,000.

ANNUAL MEETING OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS.

The forty-third annual meeting was held in New York city Jan. 15, the President, Mr. Geo. S. Morison in the chair, and a large number of members present. The first business was the reading of the reports of the Board of Direction and other officers by the Secretary, and abstracts of these reports are given below.

The committee appointed to award the Norman medal for the year ending Aug. 1, 1895, reported that the medal had been awarded to paper No. 743, "The Santa Ana Canal of the Bear Valley Canal Co.," by Mr. W. H. Hall. The committee appointed to award the Rowland Prize announced that the prize had been awarded to paper No. 755, "The Water-Works of Syracuse, N. Y.," by Mr. W. R. Hill.

The canvass of votes for the place for the next annual convention showed the usual wide range of choice, New York city leading with 30 votes, while San Francisco had 29, and there were seven other votes for points on the Pacific coast. Mr. Peterson urged the advantages of Quebec. The chairman, Mr. Morison, referred to the fact that the last two conventions have been held in the East; and, though these were the most successful in the history of the society, it is a matter for consideration whether it is not now time to hold a representative meeting in some other section of the country, although he did not think the Board of Direction would select a point on the Pacific coast unless there was evidence of a very strong desire for such selection. The matter was, as usual, referred to the Board of Directors for final action.

Reports of committees were then taken up, but there were no formal or lengthy reports. The Secretary read a letter from Mr. Sandford Fleming, Chairman of the Committee on Uniform Standard Time, reviewing the progress made during the year. Great Britain, Brazil, Austria and other countries have agreed to adopt the recommendation of the international convention held at Washington in 1884 advocating the adoption of civil instead of astronomical time for nautical almanacs, but making their adoption of this system conditional upon its adoption by the United States. The head of the United States nautical almanac, however, objects to this system, and the important gain which has been nearly reached after several years' work now seems about to fail, especially as the first day of the new century was recommended as being the most suitable time for inaugurating the new system, and the work for the nautical almanacs has to be done three or four years ahead of time. Mr. Cohen spoke strongly as to the regrettable opposition of the United States authorities, and as to the prominent part which the American Society of Civil Engineers has taken in promoting the new and uniform system. He therefore submitted a long preamble reviewing the proceedings since 1884, and a resolution, which was adopted, to the effect that a communication should be sent to the President and to Congress asking that civil time should be adopted for the nautical almanac, that this country may work in concert with the conditional action of other nations.

The Secretary then read a letter from the Sub-committee on Analysis of Iron and Steel, stating that it had been impossible to complete a report in time for presentation at this meeting. He also read a letter from Prof. Fuertes, Chairman of the Committee on Units of Measurement, referring to the progress made and to the recognition which other countries have shown as to the advantages of the metric system. This letter was accepted as an informal report, and the committee continued, with a request to present a final report at the next annual meeting. Prof. Burr asked for the formal discharge of the Committee on Tests of Structural Materials, which was practically discharged by the acceptance of its report at the last annual convention. This was done, although Mr. Smith opposed the action, considering that the committee's work was as important as that of the former Committee on Rail Sections, and that the committee should be continued.

Mr. G. Leverich presented a resolution expressing disapproval of the acceptance of courtesies for transportation, entertainments, etc., involving expense from corporations or persons outside the society, and requesting the Board of Directors to consider this in arranging for future conventions. Several speakers strongly opposed the motion, and the resolution was finally tabled.

The result of the election for officers was then read. There were 398 ballots counted, and the numbers for each officer elected are given after their names, as follows: President, Thomas Curtis Clarke, New York city (398); Vice-Presidents, William R. Hutton, New York city, (396), and P. Alex. Peterson, Montreal (392); Treasurer, John Thomson, New York city (398); Directors, George A. Just (392), Wm. B. Parsons (394), and Horace See (396), all of New York city; John R. Freeman, Boston, Mass. (398); Daniel Bontecou, Kansas City, Mo. (397), and Capt. Thomas W. Symons, Portland, Ore. (392). The president-elect, Mr. Clarke, and the retiring president, Mr. Morison, made brief remarks.

Lunch was served at the Society House, and an illustrated lecture on "The Central Station of the United Electric Light & Power Co., New York," was delivered in the evening, by Mr. H. W. Yorke.

On Jan. 16 there was a visit to the works of the Crocker-Wheeler Electric Co., at Ampere, N. J., by special train on the Delaware, Lackawanna & Western R. R. Parties also visited by invitation, the Brooklyn Bridge the new Harlem River drawbridge of the New York Central R. R., the Sprague electric elevators in the Postal Telegraph Building, and the central station of the United Electric Light & Power Co. In the evening there was a reception at Delmonico's.

In accordance with our usual custom we give herewith a full abstract of the annual report of the Board of Direction, the Auditor and the Treasurer for the year ending Dec. 31, 1895, as presented at the annual meeting on Jan. 15.

Report of Board of Direction.

Membership.—The changes in membership are shown in the following table, by which it will be seen that there has been a net increase of 112 during the year:

	Jan. 1, 1895.			Jan. 1, 1896.			Losses.				Additions.		Totals.	
	Resident.	Non-Resident.	Total.	Resident.	Non-Resident.	Total.	By Transfer.	Resignation.	Dropped.	Death.	Transfer.	Election.	Loss.	Gain.
Hon. Mem.	5	4	9	4	4	8	..	..	..	1	..	..	1	.
Corr. Mem.	....	3	3	..	3	3	..	..	..	..	..	..	..	..
Members	209	980	1,189	218	1,022	4,240	..	6	7	16	*20	60	29	80
Assoc. Mem.	42	144	186	56	181	237	9	1	..	3	†19	45	13	64
Associates	24	49	73	23	51	74	2	3	..	..	‡2	4	5	6
Juniors	87	179	266	90	188	278	30	2	1	2	..	47	35	47
Fellows	12	35	47	13	34	47	..	..	..	..	..	..	..	..
Subscribers	9	26	35	7	26	33	..	..	..	2	..	..	2	..
Total	388	1,420	1,808	411	1,509	1,920	41	12	8	24	41	136	85	197

* 9 Associate Members, 1 Associate and 10 Juniors. † 1 Associate, 18 Juniors. ‡ 2 Juniors.

The losses by death during the year number 24. They are as follows: One honorary member; John Newton; 16 members, Frank Chester Beardsley, Frederick Janorin Carrel, Robert Linah Cobb, Eckley B. Coxe, James Gustavus Dagron, Pomeroy P. Dickinson, Horace La Fayette Eaton, Charles Fred Beals Haskell, William Abbott Pike Orlando M. Poe, Willard S. Pope, Henry Frederic Rudloff, Frederick Ellsworth Sickels, Marshall M. Tidd,

Arthur Mellen Wellington, William Howard White; 3 associate members, William Sheldon Humphrey, John Frederic Temple, Charles Wood; 2 juniors, Stancliff Bazen Downes and Russell Wadsworth Hildreth; 2 subscribers, A. Chanute and William Henry Harris.

Library.—During the year $70.58 have been expended on the library (as against $388 last year), and $170.76 have been received from sales of duplicates. There have been 1,141 additions to the library, including 441 volumes, 389 pamphlets and 221 specifications. The present number of titles in the library is 19,663.

Attention is again called to the fact that the growth of the library is largely dependent upon legacies, and contributions of reports and other engineering literature from members, corporations and others who take an interest in the society's welfare.

Society House.—The expenditure for repairs and betterments of the Society House has been $86.88. The rooms have been kept open on Wednesday evenings during the year. Exclusive of the attendance at meetings, 506 members and others have consulted the library since Sept. 1, on which date a record was started.

A year ago your board called attention to the desirability of procuring enlarged quarters, and expressed the hope that the time might not be far distant when this enterprise might be undertaken. During the earlier part of this year the subject was carefully considered by your board, and on May 25, 1895, a circular was issued setting forth the needs of the Society and the importance of early action. The replies to this circular were considered by the board at its meeting at the annual convention, and were reported to the Society at the business meeting during the annual convention, together with the following resolution passed by the board:

Resolved, That the results of the canvass of the membership in regard to a new society house be communicated to the society at its next business meeting, together with the suggestion that, as the responses so far received are indicative of the feasibility of erecting a larger and more commodious building than that proposed in the recent circular, the committee of the society, if appointed, should be requested to take the fact into consideration in its action, it being the sense of the board that a more liberal provision for the future needs of the society than the circular suggested may be desirable.

The subject was discussed in the full meeting of the society, which unanimously adopted the following resolutions:

Resolved, That it is the opinion of the members of the American Society of Civil Engineers, assembled in business meeting June 20, 1895, that the present quarters are insufficient, and that new and superior quarters should be procured.

Resolved, That the execution of the scheme outlined by the resolution just passed be entrusted to the Board of Direction of this society.

Under the authority thus given by the society, the Board of Directors, after careful consideration, purchased the lots Nos. 218 and 220 West Fifty-seventh st., New York city, having a frontage of 50 ft. on the south side of Fifty-seventh st., and an average depth of 110 ft., for $80,000. The deeds for this property have been taken in the name of the society, $20,000 having been paid down in cash and $60,000 remaining on mortgage at 5% for two years, with the privilege of paying off the same at any time after one year. The location is considered specially favorable, and there is an opportunity for side lights on the east side. The authority for the purchase of this property and the sale of the present society house was given by the board of Direction on Nov. 5, 1895, by the unanimous vote of 26 members, who constituted two-thirds of the whole board. At this meeting it was voted, on motion of the oldest member of the society, that the construction and architecture of the new society house be entrusted to members of the American Society of Civil Engineers and to none others.

Plans for a building specially adapted to the uses of the society have been prepared by Joseph M. Wilson, Vice-President of the society. These plans provide for a reception room of about 1,200 sq. ft. area on the ground floor in front, and for a meeting room or theater, capable of seating about 400 persons, on the same floor in the rear. This arrangement provides full facilities for meetings and entertainments in separate rooms, while the floor can be let out for other purposes than the uses of the society, without interfering with any other portion of the house. The second floor, having an area of about 4,000 sq. ft., is arranged for the business purposes of the society. The third floor provides a reading-room of 1,600 sq. ft. in front, which will also be used as the library for reference books, and a book stack in the rear, capable of holding 150,000 volumes. Apartments for the janitor are provided in the basement. While it is believed that this will furnish all the accommodation which the society will require for many years, it is proposed to construct the walls in such a manner that additional stories may be added if required. The building will be of fire-proof construction throughout. When not required for other purposes, the reception room on the ground floor can be used as a reading and conversation room for the society. These plans will be exhibited for the consideration of the society at the annual meeting. It is expected that the library will be kept open at all times until late in the evening for the use of members and others.

The estimated cost of this building is $90,000, making the total cost of the building and lot $170,000, or $45,000 more than the plan proposed in the circular of May 25.

The difference is due to the larger facilities provided, and the proposed expenditure can be curtailed by completing only a portion of the house at once.

During the year the mortgage on the present society house has been reduced, out of the revenues of the year, to $11,500, and it is perfectly safe to estimate the house as worth $50,000 more than the amount of the mortgage. The requirements for the completion of the new society house, without appropriating any of the society funds to this purpose, will be as follows:

Cost of house and lot		$170,000
Present Society House	$50,000	.....
Mortgage on new Society House	60,000	.....
		110,000
Balance required		$60,000

The society has about $20,000 which could be expended for this purpose.

On Oct. 18, the Board of Direction issued a special circular describing the location and asking for voluntary subscriptions from members and friends of the society. In reply to this circular subscriptions have been received to the amount of $16,640, $16,365 from 221 persons connected with the society, and $275 from two outsiders. When this subscription reaches $30,000 the success of the scheme will be assured; $60,000 will carry it through without the appropriation of any other funds for this purpose. The subscriptions now referred to are absolute donations. When the scheme is more fully matured the Board of Direction will consider the propriety of exchanging the mortgage on the property for an issue of mortgage bonds bearing a low rate of interest, to be taken by members of the society.

The income of the year 1895, over and above all ordinary expenditures, was $8,715.12. The new society house, with its improved facilities, will add to the expenses of the society, but the addition is not expected to exceed $3,000, which is less than one-half the surplus for the present year, and is equivalent to the yearly dues of 200 non resident members.

Publications.—The following table gives a summary of the publications issued during 1895:

	Number issued.	Total edition of each number.	Number pages.	Plates.	Cuts.
Transactions	13	2,300	1,252	52	207
Proceedings	13	2,300	229	..	..
Indexes and table of contents	8	2,300	94	..	..
Advertisements	13	2,300	155	..	..
Bulletin	18	1,900	119	..	..
Constitution and list of members	1	2,400	170	..	..
Reprints	4	300	134	13	..
Totals	..	....	2,163	65	207

The cost of publication has been $9,745, or $12,606, including time of officers, clerks and stenographers charged to publications. From this is to be deducted $1,932 received for advertisements and $2,380 for sale of publications, giving the net cost of publications as $8,274. The net cost per member was $4.36 for 2,008 pages, or about ¼ ct. per page.

As far as possible, the wax process has been used for illustrations, thus substituting for large folding plates cuts which could be printed as part of the text. The result has been that the saving in size and printing has more than balanced the increased cost of the process, while the charges for inserting and folding plates have been very greatly reduced. Moreover, the appearance and character of the publication have been materially improved, while its form is more compact and convenient. The actual advantage to the society, upon exact reference to cost per page, shows a saving of about 30% per page on the cost for 1893 and 22% on that for 1894, which is largely due to the use of this system of illustration.

Beginning with the January number of 1896, the new system of publication will go into effect.* This system has been framed with special reference to prompt publication, to securing more thorough discussion of papers, and to placing the final issue of Transactions in a form convenient for preservation by members.

Meetings.—The annual meeting, held in New York, Jan. 16 and 17, 1895, was attended by 274 of the members and by many of the ladies of their families. The attendance at the 27th annual convention, held at the Hotel Pemberton, Hull, Mass., was the largest in the history of the society, 267 persons connected with the society, and 345 guests, including 236 ladies, a total of 612, being registered. There have been 18 regular meetings held at the society house, at which the attendance has on several occasions exceeded 100, the average being 85. There were 33 formal papers presented at these meetings, and three meetings were devoted entirely to discussions. In the oral discussion 163 persons took part, and correspondence from 67 was read.

Medals and Prizes.—The Norman medal for the year terminating Aug. 1, 1894, was awarded to E. A. Hunt, M. Am. Soc. C. E., for his paper on "A Proposed Method of Testing Structural Steel." The Rowland prize for the year terminating Aug. 1, 1894, was awarded to David L. Barnes, M. Am. Soc. C. E., for his paper on "Distinctive Features and Advantages of American Locomotive Practice." The Collingwood prize for Juniors for 1894, being the first award of this prize, was awarded to Morton L. Byers, Jun. Am. Soc. C. E., for his paper on "The Renewal of the Channel Pier of the Cincinnati & Muskingum Valley Railway Bridge over the Scioto River."

*Engineering News, Nov. 21, 1895.

Report of the Treasurer.

Balance on hand Dec. 31, 1894		$6,336.81
Receipts, Jan. 1 to Dec. 31, 1895		50,655.01
Payment of audited vouchers, Jan. 1 to Dec. 31, 1895	$35,843.72	
Payment on Fifty-seventh street property	3,000.00	
Balance on hand Dec. 31, 1895, in bank and trust company, and in hands of the Secretary	18,148.10	
	$56,991.82	$56,991.82

The following is a brief statement showing the financial results and growth for the years 1894 and 1895:

	1894.	1895.
Net receipts*	$37,100.35	$39,670.01
Net disbursements†	34,015.62	30,954.89
Surplus to the good	3,084.73	8,715.12
Dividend on expenditures	9%	28%

* Exclusive of balance taken over from past year, of receipts on New Society House and rebate on Engineering Congress expenses.

† Exclusive of investment payments and Engineering Congress expenses.

It is believed that every member of the society may well ponder over this statement, as it points to future possibilities of development, the extent of which would be difficult to estimate. In fact, when considering the financial distress of the last three years, the showing here presented would seem to justify the prediction that as good, if not better, results may be expected in the future.

John Thomson, Treas.

Report of the Auditor.

Receipts.

Balance on hand Dec. 31, 1894		$6,336.81
Entrance fees	$3,715.00	
Current dues of 1895	22,971.92	
Past dues, extended from 1894	1,220.24	
Advance dues of 1896	5,149.88	
Sales of publications	2,379.93	
New society badges	1,107.62	
Introductory cards to foreign societies	6.00	
Certificates of membership	172.20	
Advertisements	1,952.50	
Interest on invested securities	1,130.52	
Compounding dues	325.00	
Sales of library duplicates	170.76	
Rebate on taxes	4.12	
Proceedings of VIth International Congress on International Navigation	35.00	
Miscellaneous	19.92	
		39,670.01
Subscriptions to new society house		10,985.00
Total		$56,991.82

Disbursements.

Publications, net	$9,745.03	
Salaries	2,861.64	
		$12,606.67
Current business, salaries, rent of telephone, office expenses, etc.		5,231.89
Finance and accounts		2,023.00
Postage		2,313.80
Convention and annual meeting		1,891.75
General printing and stationery		1,037.77
Interest on mortgages		734.37
Taxes		439.30
Library		1,327.83
Janitor		720.00
New society badges		1,177.18
House supplies and furniture		214.10
Certificates of membership		85.47
Norman medal, Rowland and Collingwood prizes		213.40
Fuel		156.60
Gas		113.85
Water		17.00
Work of committees		22.00
Insurance		140.70
Box in safe deposit		16.00
Repairs and betterments		86.88
Other expenditures		385.13
		$30,954.89
On principal of mortgage, present society house		4,500.00
New society house: purchase of new property, legal expenses, circulars, etc.		3,388.83
		$38,843.72
Balance in bank, in trust company and in hands of Secretary		18,148.10
Total		$56,991.82

Report of the Finance Committee.

The committee submits the following comparative statement of receipts and disbursements for the past two years:

	1894.	1895.
Current receipts	$37,100.35*	$39,670.01†
Current expenditures	34,015.62‡	30,954.89‡
Excess of receipts over expenditure	$3,084 73	$8,715.12

* Do not include funds received or paid on account of Engineering Congress of 1893.

† Does not include receipts for new society house fund, amounting to $10,985.

‡ Does not include payment of $4,500 on principal of present society house, nor payment of $3,388.83 on purchase of new site.